Institutional Research

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NORTHERN ELECTRIC COMPANY, LIMITED

Price December 8, 1975	Earnings per Share* Years Ended December 31 1973	1974	1975(E)	1976(E)	P.E. Ratio on 1976(E)	Dividend	Yield
$23 1/2	$1.35	$2.05	$2.55	$3.00	7.8x	$0.60	2.6%

* After deducting losses from Microsystems International Limited.

HIGHLIGHTS

- Northern Electric, controlled by Bell Canada, is the largest manufacturer of telecommunications equipment in Canada, the second largest in North America and the fifth largest in the western industrialized world. Sales are now over the $1 billion level.

- Direct participation in A.T.& T.'s subsidiary, Western Electric, is not available to investors, while other telecommunications equipment manufacturers are widely diversified concerns. As a result, Northern Electric represents the best direct method of investing in the growth of the telecommunications equipment manufacturing industry.

- Northern Electric's sales are related to capital expenditures by telephone utilities in Canada and to an increasing degree in the U.S.A., where its sales are primarily to companies other than subsidiaries of A.T.& T. Overseas business could be of increasing importance in coming years.

- The trend of sales and earnings is good and continued gains in both can be expected over the next several years.

- The stock is of institutional quality and, while Bell Canada owns 69% of the outstanding shares, float is about $200 million. The shares are listed in Toronto, Montreal and New York and are also quite widely held overseas.

- At 7.8 times estimated 1976 earnings, the shares represent good value. Technical support appears to have been found at the $23 1/2 level. We strongly recommend purchase.

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Statistical Summary

	Past			Projected	
	1972	1973	1974	1975	1976
Sales ($'millions)	$534.3	$612.8	$970.7	$1,030.0	$1,238.2
Net Profit ($'millions)	$20.3	$32.0	$53.8	$66.8	$79.9
Earnings per share	$0.86	$1.35	$2.05	$2.55	$3.00
Price range high	n.a.	n.a.	$25 1/4	$31 3/8(1)	
Price range low	n.a.	n.a.	$15 1/2	$15 3/4(1)	
P.E. multiple range	n.a.	n.a.	7.6-12.3	6.2-12.3	
Dividend	$0.50	$0.50	$0.52½	$0.60	$0.60
Tangible book value per share	$8.12	$9.20	$10.75	$12.70	$15.10

(1) To date.

REPORT SUMMARY

The Company

Northern Electric is the largest manufacturer of telecommunications equipment in Canada, the second largest in North America and the fifth largest in the western industrialized world. It is active in virtually all sectors of telecommunications equipment manufacturing. Using its business with the Bell Canada group of companies as its solid base, it has begun to penetrate the U.S. market and this is providing a great potential for rapid growth. Furthermore, it is increasing its activity in Europe, although this will not contribute to sales and earnings growth in the short or medium term. The Company is directed by an aggressive management that has been brought in over the past five years by its major shareholder, Bell Canada. Northern Electric's sales in 1975 are estimated at $1,030 million and profit is estimated at $66.8 million.

The Telecommunications Industry

The telecommunications industry covers a broad range of services, although the area of specific interest to Northern Electric is the telephone sector. Telephony in North America is characterized by independent, investor-owned companies providing a very high level of quality of service at moderate cost to subscribers, while telephony in Europe and elsewhere is characterized by government owned telephone companies generally operated as part of the post offices (the post, telegraphs and telephones or "P.T.T.'s") and which provide a lower level of quality of service than in North America at much higher subscriber costs.

Furthermore, telephony in North America is characterized by uniformity of technical standards, thereby providing telecommunications equipment manufacturers with opportunities for economies of scale while telephony in Europe and elsewhere is marked by inconsistent technical standards from country to country and even non-uniformity within some individual countries. This has led to the proliferation of a large number of European manufacturers tied to local markets and has resulted in a very low level of international trade in telecommunications equipment.

The telecommunications industry is also characterized by rapid technological developments and the introduction of increasingly sophisticated equipment that is high in initial cost but which lowers operating costs for telephone utilities. The new generations of equipment are also assisting in the speeding up of telecommunications and are instrumental in the introduction of new services that contribute further to economic growth.

Northern Electric's Operations

Northern Electric operates 33 plants in Canada with a total floor area of 5.6 million sq.ft., 6 plants in the U.S.A. with a total floor area exceeding 345,000 sq.ft., plus plants in Turkey, Ireland and Malaysia totalling 81,000 sq.ft. It also has 48 warehouses and sales offices in Canada occupying a total of 880,000 sq.ft. and sales offices and representation in major cities in the U.S.A.

In addition to its manufacturing operations in Canada, Northern Electric has a distribution subsidiary, "NEDCO", that was established in 1972, and which distributes a broad range of electrical products, most of which are obtained from sources other than Northern Electric (81% of sales are of non-Northern Electric products) to local wholesalers for ultimate sale to electrical contractors, builders, etc.

In the U.S.A., Northern Electric has a wholly owned subsidiary, Northern Telecom Inc. ("N.T.I."), which distributes products made by Northern Electric in Canada and which also manufactures Northern Electric products in the U.S.A. N.T.I.'s sales were $91.1 million in 1974, up from $47.5 million in 1973.

In Europe, Northern Electric operates from an Amsterdam head office and has a plant in Ireland to supply the continental market and a plant in Turkey to supply the Turkish market. Recently, Northern Electric entered into a series of agreements with Thomson-CSF of France to manufacture in France certain Northern Electric products, notably the SP-1 central processor controlled electronic switch and to distribute other Northern Electric products in France. Although this move has a number of favourable long term implications, benefits to Northern Electric will not be forthcoming in the short to medium term and the total value of the benefits to Northern Electric is also unknown. At the very least, this represents the beginning of a penetration by Northern Electric of the European market.

Research and Development

Northern Electric maintains the largest independent research laboratory in Canada; in 1974, it spent $44.1 million on research and development. Most of this spending is through its 49% owned company, Bell Northern Research, whose majority

shareholder is Bell Canada (51%). Research is done on all sectors of telecommunications and the list of credits resulting from this research and development to date is impressive. They include the Contempra and Logic 10 telephone sets, the SP-1 stored program processor controlled electronic central office switching system, the Pulse electronic P.A.B.X. and the LD-4 high capacity digital transmission cable. All research and development expenditures are expensed by Northern Electric as incurred.

Sales

Northern Electric's sales in 1974 were $970.7 million of which 86.5% were to Canada, 9.4% to the U.S.A. and 4.1% overseas. By comparison, 2 years earlier, sales were 90.9% to Canada, 5.0% to the U.S.A. and 4.1% overseas. These statistics indicate the importance of the Company's basic Canadian business while showing the growing importance of the U.S. market. The Bell Canada group of companies accounted for 53.8% of total sales in 1974 and other Canadian customers 32.6%.

In 1974, sales by product categories were divided 32.3% from switching equipment, 19.7% from wire and cable, 18.7% from subscriber apparatus and business communications systems, 10.6% from transmission, 16.3% from the distribution of non-company manufactured products and 2.4% of other miscellaneous items. These percentages are expected to remain approximately stable in the foreseeable future.

Sales in 1975 are expected to be about $1,030 million, and are expected to increase to $1,238 million in 1976 and to $1,425 million in 1977.

Profits

Northern Electric's profits in the several years prior to 1971 varied from year to year and did not show any firm trend. For example, profits in 1965 were $8.6 million, in 1967 $2.3 million, in 1969 $11.0 million and in 1970 $4.1 million. With the change in management which occurred in the early 1970's and the subsequent emphasis on profitability as well as with the restructuring of the Company's operations, profits for the past five years have shown a steady increase. Thus, profits which in 1970 were $4.1 million rose steadily to a total of $53.8 million in 1974. This was equivalent to a profit of $2.05 per share in 1974 compared to $1.35 in 1973. In the current fiscal year, an increase in profit to approximately $66.8 million, equivalent to $2.55 per share is expected. This is after deducting 17¢ per share resulting from losses incurred in 1975 from Microsystems International Limited and also resulting from the cost of closing down Microsystems. In 1976, an increase to approximately $80 million is expected which would be approximately $3.00 per share.

The Canadian federal government's wage and price guidelines should not affect profits generated by the Company's U.S. subsidiary nor will it affect income brought in from overseas such as any potential royalty from the agreement with Thomson-CSF of France. On the other hand, the Company's Canadian business will be affected inasmuch as its profit margin on its distribution business has been increasing steadily and its profit per product in its manufacturing operation has been rising. Consequently, we would expect that the Company's Canadian operations will be under pressure from the government for profits to be kept reasonably level either on a per unit basis or as a percentage of sales.

The Company's net profit was divided $44.6 million or 83.0% of the total from its basic Canadian operation plus a small amount of profit from its European sales, $5.3 million or 9.8% of the total from its distribution organization and $3.9 million or 7.2% of the total from the U.S.A. In the current fiscal year, profits are expected to be divided approximately $51.6 million or 77.2% of the total from Canadian sales, $10.5 million or 15.7% of the total from the distribution organization, and $4.7 million or 7.1% of the total from the U.S.A.

Dividend

Northern Electric's current annualized dividend rate is 60¢ per share. With the increase in earnings, further dividend increases could be expected; however, the Canadian federal government's guidelines will prevent any increase at least over the next year. Because the regulated rate of return on total capital of Northern Electric's major shareholder, Bell Canada, is much lower than Northern Electric's rate of return, an increase in the payout ratio is not expected.

Capitalization

Northern Electric's total capital at July 31, 1975 was $382.2 million, comprising 16.3% of long term debt and 83.7% equity. Net tangible book value per share at July 31, 1975 was $11.73 and return on equity in 1974 was 20.3%. The number of shares outstanding was 26,469,287 at July 31, 1975.

Market Action

Northern Electric's stock was issued at $15 in December, 1973 and rose to the $25 1/2 level in July 1974, but subsequently dropped back to $14 1/2 in December, 1974. It then entered an uptrend to $31 in July, 1975. The sale of additional stock by Bell Canada, combined with the weak Canadian market resulting from the government's anti-inflation moves, took the stock to a recent low of $23 1/4. At its current price of $23 1/2, it represents very good value. The stock in the hands of the public totals 7.9 million shares for a value of about $200 million. In addition, there are 2 million warrants outstanding to purchase, on a share for share basis, stock held by Bell Canada at $21.50 per share; the warrants are exercisable up to December 1, 1979.

Conclusion

We conclude that Northern Electric's sales and earnings growth will likely be impressive at least to the end of the 1970's as the Company utilizes its strong base of business in Canada to penetrate the U.S. market which offers excellent potential. The European market offers potential for business in the 1980's. The stock price has declined to a level that offers exceptional value and we recommend that the stock be bought.

NORTHERN ELECTRIC COMPANY, LIMITED

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NORTHERN ELECTRIC COMPANY, LIMITED

Introduction

Northern Electric Company, Limited is one of the few companies in the western world that gives investors the opportunity of participating in the growth and development of the telecommunications industry in North America, and, to a limited but growing extent, in Europe and other parts of the world. It is the second largest manufacturer of telecommunications equipment in North America and the fifth largest in the world. It is active in the manufacture of all major types of telecommunications equipment and has developed a number of proprietary products that have enjoyed impressive acceptance by telephone utilities throughout North America. Its research and development efforts, which are devoted almost entirely to the telecommunications industry, are the largest in private industry in Canada and rank high in a world context; the Company's research laboratories have a number of achievements to their credit and additional developments are anticipated over the next several years.

Northern Electric is in the forefront of scientific developments in all sectors of telephony, particularly in switching and transmission. Because of the Company's involvement in the scientific field, this report on Northern Electric begins with a discussion of the telecommunications industry and a basic explanation of technological trends. It also discusses the state of telephony in North America and Western Europe.

The second section of this report describes Northern Electric's manufacturing operations, the products it makes and its international activities.

Finally, the third section focuses on the financial analysis of the Company, leading to a forecast of sales and earnings. It also includes an analysis of the trends in a number of key financial ratios and of the balance sheet.

THE TELECOMMUNICATIONS INDUSTRY - A BRIEF SUMMARY

Background

The steps taken in the transmission of a message (i.e. data, television, telephone conversations, etc.) in modern telecommunications are presented graphically in chart 1 on the following page.

As can be seen from the chart, telecommunications covers a very broad range of services. Of particular interest to a study of Northern Electric are telephony and related services. This specifically refers to telecommunications with the following characteristics:

a) reliance on a fixed network (land lines, radio telephony or a combination),

b) individual identification of subscribers (e.g., by a telephone number),

c) freedom and ease of contact among subscribers,

d) availability of services to the public at large.

This, therefore, includes telephones, telex, telegraphy, teletype, facsimile transmission, and data telecommunications. It specifically excludes broadcasting (radio or T.V., including cable T.V.).

The most important sector of telephony as described above in terms of the cost of equipment is switching which, as the name implies, directs the subscribers' calls to their proper destination. It accounts for approximately 35%-40% of spending on equipment and for approximately 20% of the telephone carriers' capital spending on telecommunications services. In chart 1, this refers to the group called "Central Switching Office".

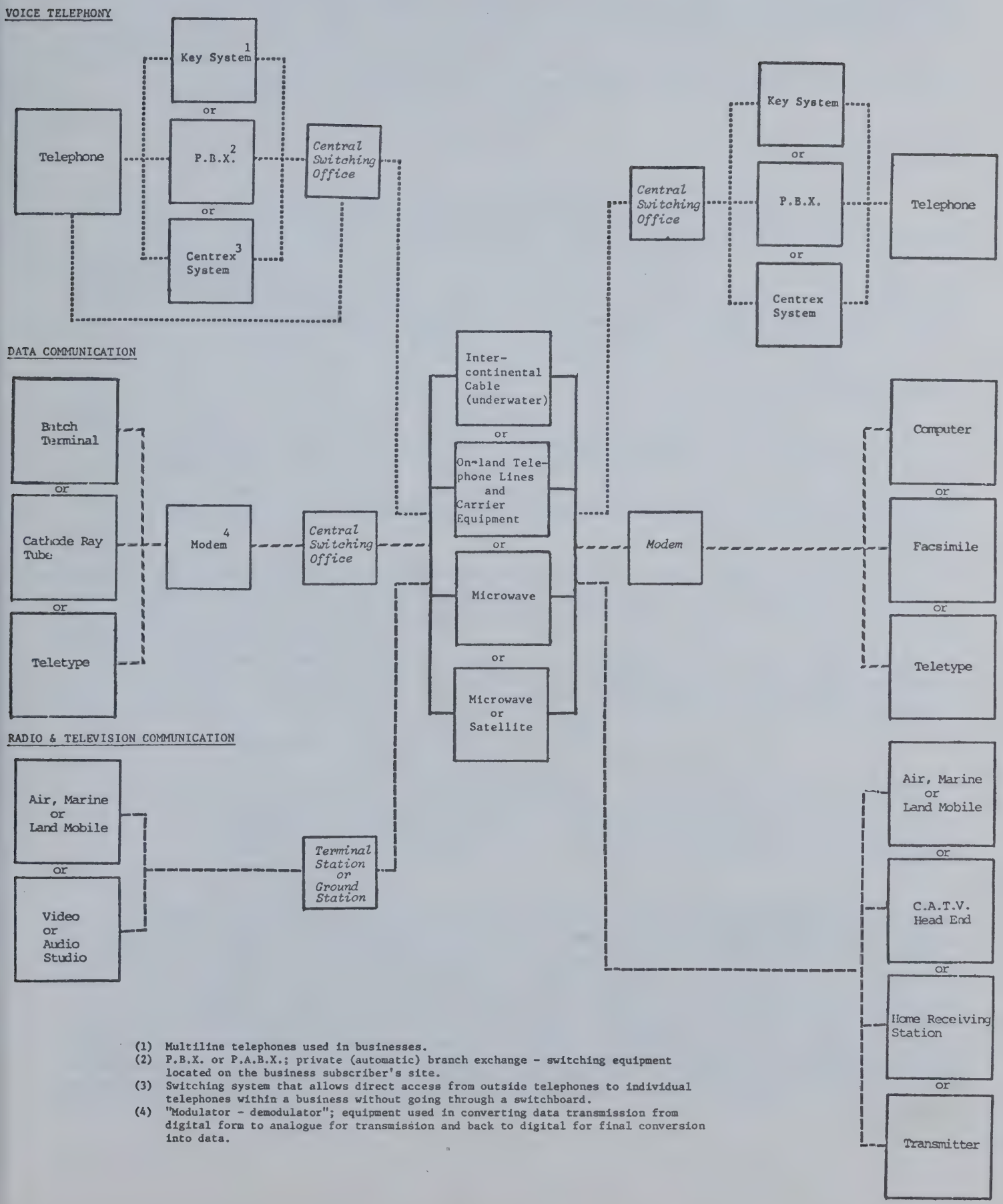
Switching is followed in importance by spending on transmission equipment which, as the name implies, carries the telecommunication from the source to its ultimate destination. It comprises cable, overland wires, microwave radio links and satellites, i.e. the central groups in chart 1. In total, transmission equipment (including cable and outside plant, i.e. telephone poles, etc.) accounts for about 35% of equipment purchases. The remaining major category covers subscriber apparatus, i.e. telephone sets, data and teletype terminals, etc.

Technological Trends

Since the Second World War, the technological changes in telecommunications have been rapid, with the major changes having occurred in the field of exchange equipment. These developments in part represented the civilian application of new technologies resulting from the second world war, but, more important, they were a response to the growing demand for services of all types. By demand for services is meant more than the demand for home telephone services; it includes the needs by business and industry for a broad range of communications services, including teletype, telemetry, data transmission, facsimile transmission, video-phones, etc. In fact, the rapid increase in the number of new services and their wide acceptance has

Chart 1

Schematic of Telephone System



(1) Multiline telephones used in businesses.
(2) P.B.X. or P.A.B.X.; private (automatic) branch exchange - switching equipment located on the business subscriber's site.
(3) Switching system that allows direct access from outside telephones to individual telephones within a business without going through a switchboard.
(4) "Modulator - demodulator"; equipment used in converting data transmission from digital form to analogue for transmission and back to digital for final conversion into data.

required a commensurate increase in transmission capacity and the development of other new products; in addition, this has fed on itself and has generated even greater demand for more sophisticated products.

In this section, we will commment briefly on the more significant technological trends, beginning with the background of switching technology.

History of Switching

The three major stages in the development of telecommunications switching have been manual, electro-mechanical, and electronic. Manual exchanges were part of the early development of the telephone system and they still exist in remote areas although they are used in only a very small percentage of total calls made. The manual exchanges were exactly as their names implies, i.e. the switching of communications from one telephone to another was done manually by operators.

Step-by-Step

The next step was the replacement of manual exchanges by "step-by-step" electro-mechanical exchanges which began in a major way in the 1920's. One of the switches that proved to be very popular and in fact is still used extensively, particularly in the United Kingdom, is the Strowger design which is named after a Kansas, U.S.A., designer.

As the name implies, in "step-by-step" switching, connections are set up in steps as directed by the telephone dial. When a call is dialled, the first number dialled, say a "3", the first switch in the telephone company's central office steps to the corresponding third level, and then an idle path to the next switch is found to receive the next digit dialled, etc., until the entire number has been dialled. This system does the switching job quite well, and is still in very wide use. However, it has limitations, namely:

- all the switches used in calling a number are tied up for the entire duration of the call,

- maintenance and expansion of the system is labour intensive.

Crossbar

The next development, which was still within the electro-mechanical generation, but which represented a great improvement, was the crossbar system which was developed in the 1930's. Within ten years of its introduction, the demand for crossbar exchanges accelerated considerably, corresponding to the period when the original Strowger equipment had to be replaced and also corresponding to the period when a number of telephone utilities installed their first automatic exchanges. Extensive use of crossbar in Canada began in 1956. By the mid 1960's, the demand for crossbar had surpassed the demand for all other electro-mechanical exchanges. The demand for crossbar still appears to be quite strong and likely will continue at a high level until the late 1980's.

The crossbar switch is a mechanical switch that utilizes a common permanently wired control unit to issue instructions to the switches. It offers significant advantages over step-by-step switches in terms of speed of operation, small size, lower initial cost and lower maintenance cost. Also, the crossbar permitted the introduction of new services, particularly Centrex dialling.

The limitations of the crossbar switch are:

- labour intensive maintenance,

- high cost to operate in comparison with electronic switching and difficulty in changing operating instructions because of the permanently wired controls.

Electronic Switching

The latest development in switching technology was the introduction of electronic exchanges in the mid 1960's. Originally, these replaced to varying degrees the mechanical switches with electronic switching methods. Since then, however, the degree of solid state electronics used has increased considerably and wired connections have been replaced by printed circuits. The major improvement in electronic switches, however, came with the introduction of stored-program control computers ("S.P.C."). The stored-program computers carry out a number of control functions and, in essence, select the path that a conversation or series of data will take.

The stored-program computer, by concentrating all the logical control functions and data in a central processor which can then be changed by altering the software, permits a flexibility and variety of switching facilities that could be achieved in electro-mechanical equipment only at great cost. Furthermore, the S.P.C. offers the advantages of low maintenance, relatively short time to accomplish the switching compared to electromechanical systems and permits the introduction of a broad range of new services.

The deliveries of electronic switching systems began in the mid to late 1960's and probably will show a very rapid growth in the late 1970's and in the 1980's. The reasons for suspecting that large scale deliveries will occur towards the end of the 1970's and into the 1980's are that:

1. the replacement of existing Strowger and crossbar systems will begin; the first 30 year cycle - the 1920's to the 1950's - saw the introduction of electro- mechanical systems while the second cycle from the 1950's to 1970's consisted of the large scale installation of the crossbar system;

2. telephone utilities in North America and Europe are currently making plans to install sophisticated electronic switching systems and the lead time from planning to installation is about two years in North America and much longer in Europe.

The first stored program system, the #1 ESS, was put into service in the U.S.A. by A.T.& T. in 1965 and, starting in 1967, Northern Electric produced and installed 11 of these systems in large Canadian cities. Since then, there have been several systems introduced by different manufacturers, including the SP-1 by Northern Electric.

The next development in central office electronic switching will be the replacement of the space division switching techniques currently used, by time division switching, otherwise known as "digital" switching. In space division switching, the connections in the electronic switching system are physical using mini-crossbar connectors, reed relays, etc., whereas in time division switching, the total operation is electronic with the electrical contacts being replaced by an electronic printed circuit. Time division switching permits the handling of a large number of communications simultaneously and permits the introduction of additional services. Digital switching in central offices is still embryonic; to date, there is no large-scale commercial digital switch in operation. However, a number of companies are in the process of developing fully electronic digital switches; for example, the Western Electric #4 ESS electronic switch is scheduled to be installed in six U.S. cities in 1976.

In private automatic branch exchanges (P.A.B.X.) which are much smaller than telephone utility central office switches and which are located on business subscribers' sites, digital switching is already a reality with a number of products being offered by different manufacturers. Northern Electric's digital P.A.B.X. is its SL-1.

Transmission Technology: Digital Pulse-Code Modulation vs. Analogue

Transmission technology has also shown some very significant improvements. At present, the majority of voice communication is in the analogue form, although the trend is to digital techniques.

In digital communication, information is transmitted in the form of a sequence of numbers which are called "code words" and which are represented by electrical pulses called "pulse codes". Hence, the process is called "pulse-code modulation". The pulse codes are generally expressed as "binary numbers", i.e. as a sequence of 1's and 0's which is the same language used in computers. Although other number systems are sometimes used, binary digits have a particular advantage, i.e. being 0 or 1 they can be expressed simply by the presence or the absence of an electrical pulse, the presence of an electrical signal representing 1 and the absence representing 0. Furthermore, transistors and modern integrated circuits are admirably suited to binary communications systems because they can be rapidly switched from being fully conducting to being non-conducting.

The bulk of communications traffic originates as analogue signals, e.g., telephone conversations, radio and television signals, etc. On the other hand, data from computers, etc., is already in digital form. Analogue signals are represented by continuous fluctuations of electric voltage or current e.g., in telephony, the speaker's voice is transferred into an electrical current through the diaphragm in the telephone and the voltage amplitude varies according to the intensity of the voice. To convert an analogue signal into a digital signal, an encoder is used to sample and measure the analogue signal voltage at frequent intervals and to assign to each sample a numerical value. At the other end, a decoder is used to restore the signal to the original analogue form. (In practice, this device is called a "codec", i.e. coder-decoder). Each number which is assigned to the sample is then represented as a series of 0's and 1's which can easily be transmitted. A simple mathematical theory shows that no information is lost if the analogue signal is sampled at a rate that is at least twice the highest frequency component in the signal. For example, in voice signals, which vary from 400 to close to 4,000 cycles per second, the signals must be sampled and measured up to about 8,000 times per second in order for the information not to be lost while a television signal should be sampled at about 10 million times per second.

A graphical representation of the conversion of analogue signals into digital signals can be shown in the following illustration.

Chart 2

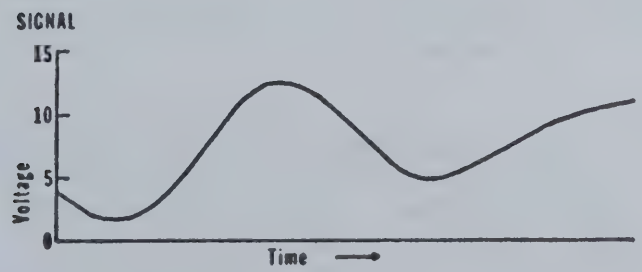
Conversion of Analogue Signal to Digital and Vice Versa

This indicates that the pulse-code modulation system consists of an encoder, which converts the analogue signal into a stream of digits, a transmission facility which delivers the digital to the receiver and a decoder which converts the digits back into an analogue signal.

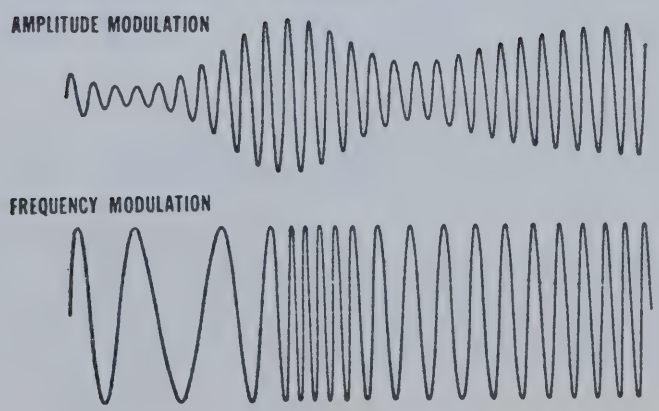
A graphic illustration of the two different types of analogue modulation and of pulse-code modulation is seen in the following:

Chart 3

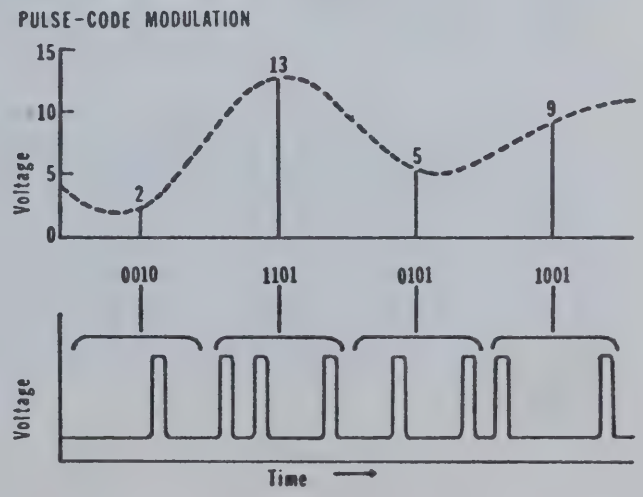
Analogue Modulation vs. Pulse-Code Modulation



Analogue



Digital



As shown on the previous page, an analogue signal can be modulated for transmission by at least three different methods. In amplitude modulation, the amplitude of a high frequency carrier wave is modulated by the voltage of a signal wave. In frequency modulation the carrier frequency is varied by the amplitude of the signal. In pulse-code modulation the voltage of the analogue signal is first sampled and the values of the samples are expressed as binary numbers. The binary numbers are in turn transmitted in the form of a pulsed, or digitized, signal wave. In practice, the samples are coded using eight pulses called "bits".

Pulse-code modulation is an idea that, while it is new in practice, is not new in theory. Several early patents embodied one or more of the basic concepts. In fact, the recognized father of pulse-code modulation is A.H. Reeves of the U.K. whose basic pulse-code patent was issued in 1938. The problem, however, was that these concepts were not easily reduced to practice because of difficulties with vacuum tubes.

Successful pulse-code modulation systems were built for use by the military in World War II but they had severe limitations and they were unattractive for commercial purposes. The limitation was primarily related to the use of vacuum tubes which are too big, consume too much power and are too prone to fail to be used in large numbers. Furthermore, vacuum tubes are good amplifying devices but are not good switching devices and a pulse-code modulation system requires switching devices that can be turned on and off very rapidly. This is precisely an advantage of transistors and integrated circuits which began to be used following the invention of the transistor in 1948. Preliminary models of pulse-code modulation were tested in 1958 and operation of commercial systems began in 1962.

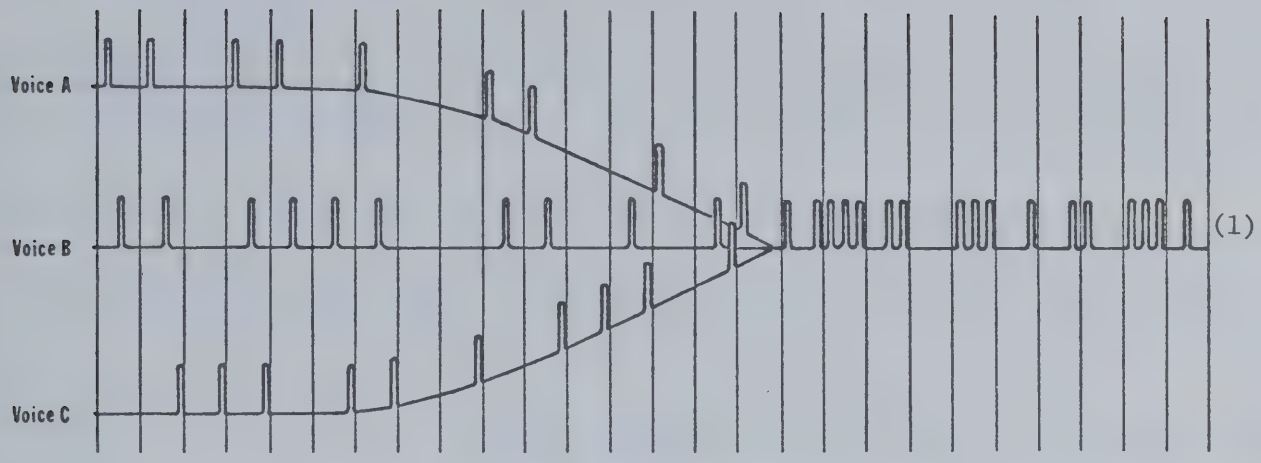
Pulse-code modulation is now extensively used in a technique called time division multiplexing in which a signal is coded and in which several coded digital signals are interleaved in time and carried on a single channel.

Previously, frequency division multiplexing was the predominant method of combining several conversations on, for example, a single cable. Frequency division multiplexing takes a number of voice or program channels and stacks them so that they occupy a frequency range. For example, human speech has a frequency range from about 400 cycles per second to 4,000 cycles per second. Thus, in frequency division, many such channels are taken and placed one above another in terms of frequency; e.g., the first channel will cover 60,000-64,000 cycles, the second 64,000-68,000, the third 68,000-72,000, etc. The net effect is that instead of having many individual channels, only one channel with a much broader frequency range is used.

A graphic representation of time division multiplexing in which three signals are interleaved and carried on a single channel is shown on the following page.

Chart 4

Multiplexing



(1) For purpose of illustration only; the amplitude samples of the original wave form are in the form of an eight bit code.

As shown above, in time-division multiplexing several digital signals are combined into high speed pulse trains. In this schematic representation, narrow pulses from three encoders are interleaved to form a single pulse train. The fact that voice signals are used to illustrate in the above example is unimportant; digitized signals of all types can be interleaved in the same way. The three pulse streams can be easily separated at the receiver, provided that a reference timing signal (called the framing signal) is available there. The framing signal in this case identifies the A pulse position; the B and C pulse positions are generated by an electronic counter that is synchronized to the framing signal.

The first large scale application of pulse code modulation was used to transmit simultaneously 24 telephone conversations over two pairs of telephone wires. Northern Electric, today, has the LD-4 system (discussed on page 45) in operation which can carry over 4,000 voice channels via a pair of coaxial tubes utilizing 274 megacycle per second pulse train.

Wire pairs attenuate (i.e. weaken) the digital signals so severely that transmission is limited to very short distances if regenerating devices called repeaters are not located at intervals along the cable to restore the signal strength. These repeaters are installed approximately every 6,000 feet.

The fundamental advantage of pulse-code modulation over analogue transmission for telephony arises partly from the nature of the repeater and partly from the fact that transmission equipment requirements are less stringent and therefore lower in cost than for frequency division multiplexing. In conventional AM systems, the repeaters are really nothing more than a high quality amplifier and therefore they amplify noises of all kinds along with the signal. Sources of noise include the extraneous noise picked up by the cable, noise coupled in from other conductors (i.e. cross talk) and thermal noise due to the random motion of electrons in the cable and in the amplifier circuits. The analogue amplifier has no mechanism for separating the signal from noise.

The pulse-code modulator repeater is not a conventional amplifier but rather a circuit designed to detect the on and off state of the digital pulses. A moderate amount of noise added to a pulse does not alter the basic fact that a pulse is present. Conversely, if a pulse is absent from a particular time slot, a considerable amount of noise must be present before there will be a false indication of a pulse. In other words, a repeater for digital signals, which is normally called a regenerative repeater, can receive a digital pulse train that is highly contaminated by noise, detect the clean signal, regenerate it to its original form and pass it along to the next repeater.

As time division switching develops, the bulk of communications will be in the form of binary digits including voice, television, video telephone, data, etc. Once digitized, all signals will be in the same electrical format and will then be intermixed by time division multiplexing without incurring penalties in cost or performance.

Future Developments: Wave Guides and Optoelectronics

Because coded signals can use regenerative pulse techniques, they are suited for use with wide band transmission mediums, which are all in the experimental stage, such as wave guides, fibre electronics, laser beams, etc.

A wave guide consists of a metal pipe whose inner surface is precisely engineered. For example, it can be in the helix form, i.e. a structure consisting of a continuous wrapping of fine copper wire on the inside of a steel pipe. A wave guide normally supports several modes of propagation and the function of the wire in a lining is to suppress all but the desired mode that has mimimum loss. Using pulse-code modulation, a wave guide could theoretically simultaneously transmit at least 180,000 two-way telephone conversations or 300 colour television programs. Attenuation is so low that repeaters could be spaced 20 miles apart. An intercity wave guide could be economically attractive, although only on routes with very high traffic.

The most exciting potential development lies in the field of optoelectronics which uses lasers to emit a light beam which is then modulated to carry a signal through a thin glass fibre. Light waves can be modulated at very high frequencies so that optical fibres can carry much more information than normal copper wires. Furthermore, the fibres are totally immune to the kind of electrical interference that affects normal telecommunications, for example, sunspots, near-by power cables, etc. This has a revolutionary potential; if successfully developed, it could replace much of the existing communications systems with a new technology. Optoelectronics may offer potential economies to the telecommunications industry over conventional copper wire transmission technology similar to that of the semi-conductors over the vacuum tube industry 20 years ago.

Optoelectronics became feasible with the development of hair-thin glass fibres so clear and so pure that light signals can be transmitted 10 miles or more before they are attenuated to undetectable levels. These fibres could, therefore, replace tons of copper since a single thin fibre using the pulse-code modulation method of transmission can carry several television channels, thousands of voice channels and several data signals.

Interest in optoelectronics and fibre optics picked up in 1966 following the publication of a paper by ITT's Standard Telecommunications Laboratories in the U.K. In 1970, researchers at Corning Glass produced a super transparent fibre from glass made by reacting ultra-pure silicon chloride and oxygen.

The potential is so great that research on the subject, which was virtually non-existent ten years ago, is accelerating. Currently, about $100 million is being spent annually and this will probably double next year. All the major manufacturers with research facilities are doing work in this field, including Bell Laboratories (which is doing the major work on the subject), Corning Glass, RCA, G.T.& E., ITT, Thomson-CSF in France, as well as Northern Electric in Canada, etc.

Developments in the field have been extremely rapid. There were so many problems as recently as 1972 that expectations were that fibreoptic systems would not be developed until, at the earliest, the 1990's. Many of the major problems were in solid-state physics such as the control of impurity levels in the glass and the development of new kinds of light sources such as solid-state lasers and light emitting diodes. Most of these problems have been solved over the past 18 months. One of the researching groups, GTE Laboratories Inc., will be proceeding with the first experimental field demonstration of laboratory-built equipment next year.

Optical transmission has three basic components, namely, 1) a variable light source at one end such as a laser or a light emitting diode ("L.E.D."), 2) a fibre that, when viewed from one end, looks like a long mirrored tube, and which lets virtually no light escape, and 3) at the other end, a small sensing device, usually a semi-conductor diode, which converts the light levels or flashes of light back into electricity.

The basic raw material of fibre optics and optoelectronics is silicon oxide, the basic ingredient of sand and rock. It is readily available in large quantities and can be obtained at low prices. Furthermore, only tiny amounts are required to produce optical fibres several kilometres long which would replace thick telecommunications transmission cables.

Currently, Corning Glass in the U.S.A. is supplying an experimental cable that costs $13.50 (U.S.) per metre, containing six separate fibres. In total, the cable is only about one-quarter inch thick and weighs only about 88 pounds per mile. In experiments, one of the Corning fibres, more than six miles long, has carried 33,000 telephone conversations simultaneously.

Understandably, the $13.50 per metre price for the experimental cable would come down considerably with mass production, possibly to pennies per metre. If that were to occur, there would be a great incentive for telephone utilities to replace existing copper cables.

Summary

In summary, the next area that will be developed is that of digital time division central office switching. In fact, some manufacturers will be introducing such a product over the next 12-18 months. Subsequently, a number of other developments are actively being studied and these could lead to the production and sale of new products in the coming decades; notably, the field of fibre electronics offers great potential.

TELEPHONY

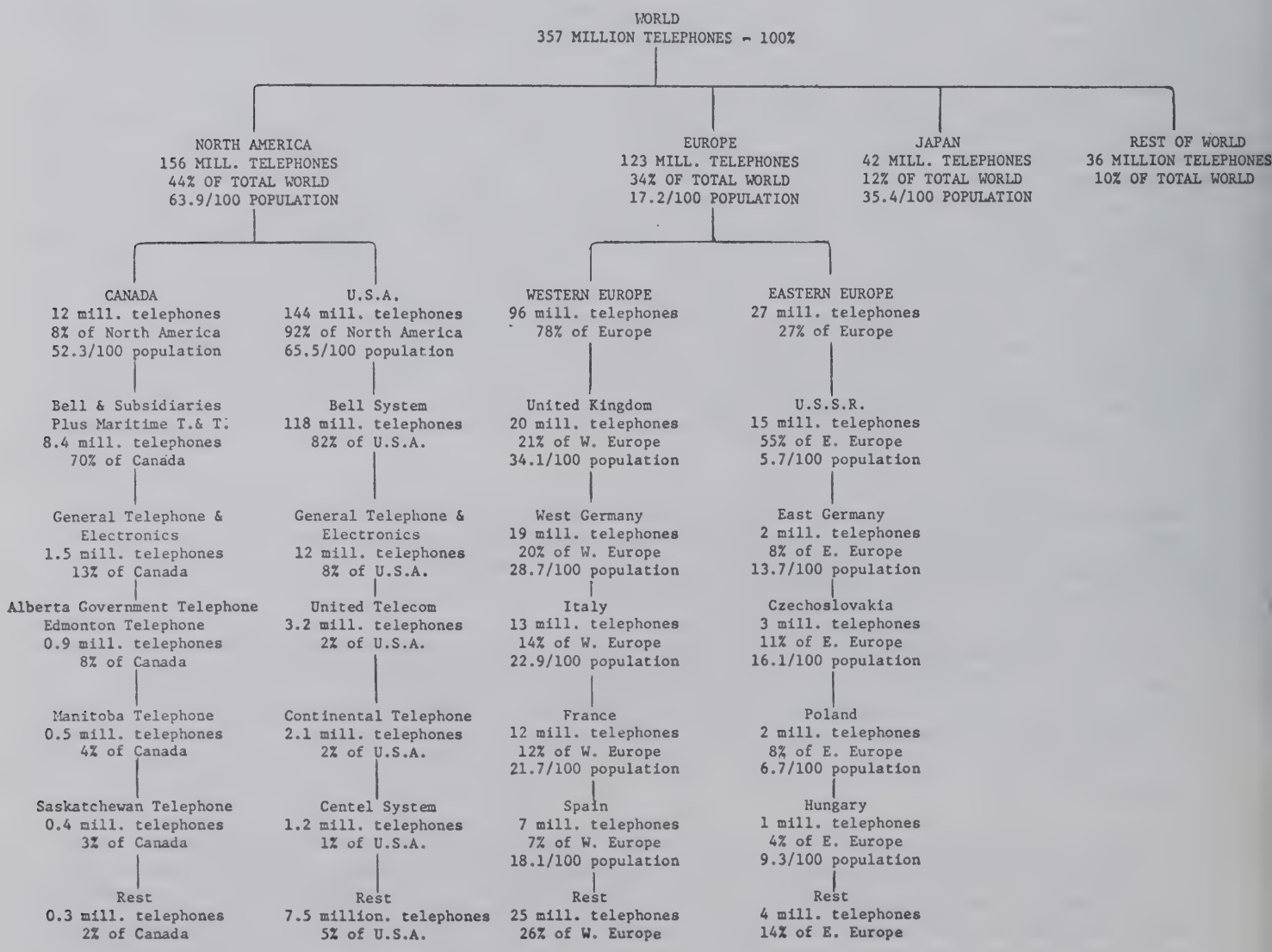
Background

In most countries of the world, the telephone industry is directly or indirectly an arm of the government, being in most cases part of the post office. The major exception to this is in North America where the bulk of the telephone business is handled by independent companies, although they are closely regulated by government agencies.

The distribution of telephones in the world is as follows:

Chart 5

World Telephones at December 31, 1974



Source: Telecommunications Market; May, 1975, Northern Electric Co., Ltd.

The relative importance of world markets in 1973 for telecommunications equipment is shown in the table on the following page.

Table 1

Relative Importance of World Telecommunications Equipment Markets 1973

	Market(1) $ billions	% World market	Number of telephones	Telephones per 100 inhabitants	Telephones as % of free world total
U.S.A.	$5.0	34.0%	132.5	66.0	48.0%
Canada	0.2	1.4	9.8	45.6	3.5
Total North America	$5.2	35.4%	142.3	63.9	51.5%
United Kingdom	0.9	6.1	17.6	31.4	6.4
West Germany	1.4	9.5	16.5	26.7	6.0
France	1.0	6.8	10.3	19.8	3.7
Italy	0.7	4.8	11.3	20.7	4.1
Sweden	0.1	0.7	4.8	59.3	1.7
Netherlands	0.2	1.3	4.0	29.8	1.4
Belgium	0.1	0.7	2.3	23.5	0.8
Total Seven	$4.4	29.9%	66.8	26.9	24.1%
Other W. Europe	0.9	6.1	16.7	24.5	6.1
Total W. Europe	$5.3	36.0%	83.5	25.3	30.2%
Japan	1.9	12.9	30.1	28.7	10.9
Australia	0.2	1.3	4.2	32.4	1.5
Other Far East	1.0	6.8	1.5	0.1	0.5
Latin America	0.7	4.8	10.1	3.1	3.6
Middle East	0.2	1.4	1.9	1.4	0.7
Africa	0.2	1.4	2.9	0.7	1.1
Total Free World	$14.7	100.0%	276.5	8.2	100.0%

Sources: Euro Economics: Telecommunications Industry in Western Europe, 1975.
Post Office Report & Accounts, 1973/74, HMSO, London, United Kingdom.
Bundesministerium für das Post - und Fernmeldewesen, Geschäftsbericht des Deutschen Bundespost 1973, Bonn, West Germany.
INSEE, Annuaire Statistique de la France, Paris, France.
Italian Statistical Yearbook, 1972. Instituto Centrale di Statistica, Italy.
Statistiska Centralbyrån, Statistisk Årsbok, Stockholm, Sweden.
Jaarsverlag 1973, Staatsbedrijf der PTT, - Gravenhage, 1974, Netherlands.
Régie des Télégraphes et des Téléphones, Rapport Annuaire 1972, December, 1974, Brussels, Belgium.

(1) Total sales in the individual domestic markets or areas.

The major source for the data shown above is the 1975 report "Telecommunications Industry in Western Europe", by Euro Economics, which is the economic research arm of Eurofinance S.A. which, in turn, is owned by leading banks in Western Europe, North America and Japan. This report is the most serious and comprehensive study that we have discovered on the telecommunications industry of Western Europe. As indicated later in our report, comprehensive and consistent statistics on telephony in Europe are non-existent, and Euro Economics' effort at providing a picture of the size of the telecommunications market and of trends therein is excellent. It must be realized, however, that the information above is meant as a general guideline and should not be taken as being absolutely accurate. In fact, the value of the market in Canda shown above is much too low.

In the following section we will comment on the characteristics of these markets separately, starting with the largest market, North America.

North America

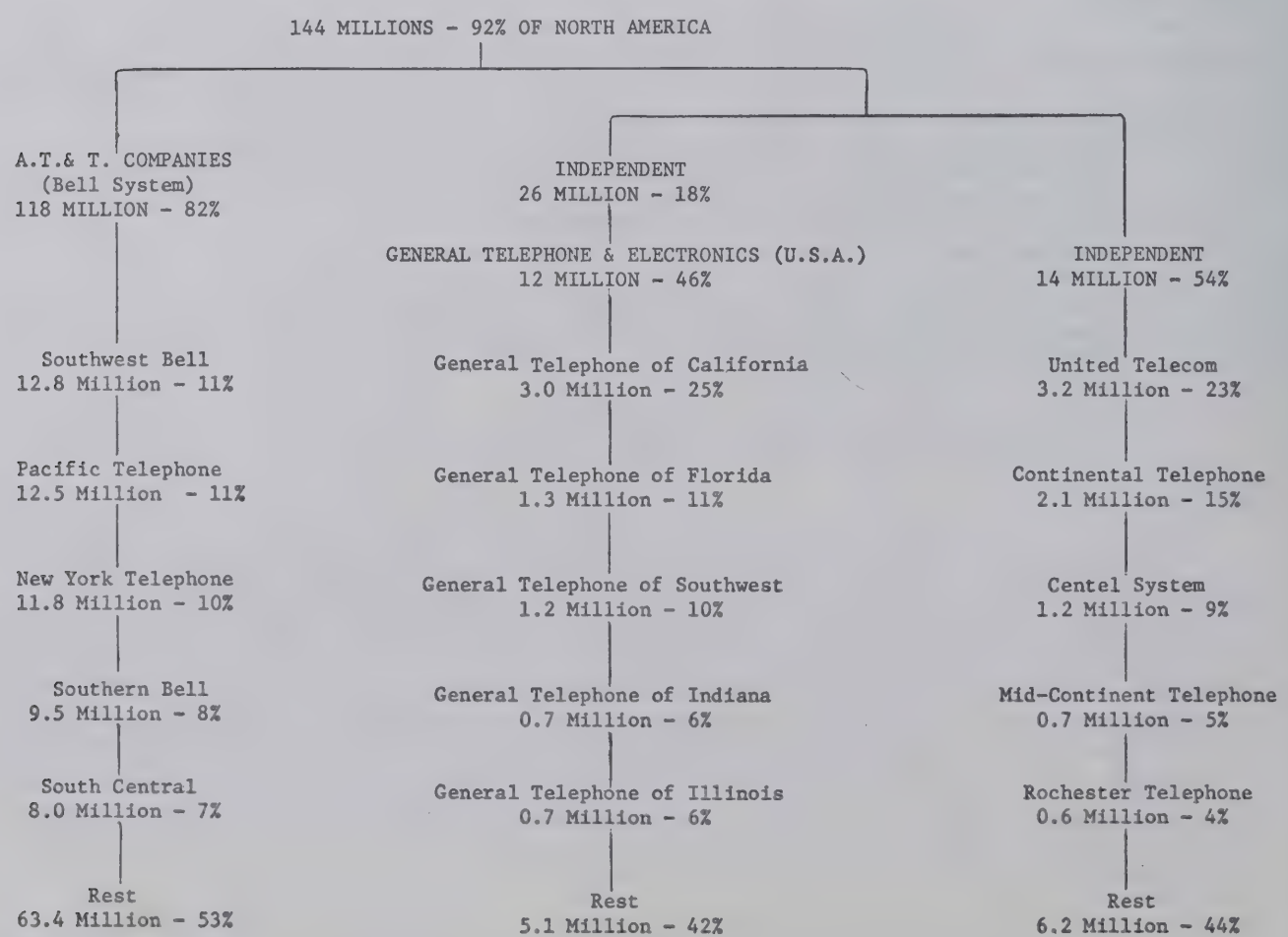
A unique characteristic of the situation in North America is the fact that telecommunications systems are completely compatible, i.e. a piece of equipment made for a telephone company in any part of North America is useable in any other part of the continent. This has very positive implications for the telecommunications equipment manufacturing industry since, at the very least, it offers economies of scale and provides greater opportunities for product improvement. In general, North American subscribers enjoy the world's highest quality telephone service at the lowest cost.

U.S.A.

The U.S.A. at December 31, 1974, had 144 million telephones in operation, divided as follows:

Chart 6

Telephones in the U.S.A at December 31, 1974



Source: Telecommunications Market; May, 1975, Northern Electric Co., Ltd.

The trend in a number of key statistics for the telephone industry in the United States is presented below:

Table 2

U.S. Telephone Industry Statistics, 1950-1976

	1950	... 1960	... 1970	... 1972	1973	1974	1975(Est.)	1976(Est.)
No. of Telephones ('000)								
A.T.& T.	36,796	62,989	99,902	108,811	113,960	118,146	122,200	127,000
Others	6,338	11,340	20,312	22,796	24,351	25,826	26,900	28,200
Total	43,134	74,329	120,214	131,607	138,311	143,972	149,100	155,200
Operating Revenues ($'000)								
A.T.& T.	$3,345,108	$8,110,562	$17,368,544	$21,388,000	$24,072,000	$26,761,000	$29,150,000	$31,900,000
Others	314,078	1,008,451	2,891,814	3,788,699	4,316,990	4,900,000	5,400,000	5,940,000
Total	3,659,186	9,119,013	20,260,358	25,176,699	28,388,990	31,661,000	34,550,000	37,840,000
Total Plant ($'000)								
A.T.& T.	$10,415,335	$24,755,378	$56,171,376	$68,492,000	$75,520,000	$82,700,000	$89,600,000	$97,300,000
Others	1,086,764	3,970,578	12,390,327	15,555,142	17,418,533	19,600,000	21,400,000	23,500,000
Total	11,502,099	28,725,956	68,561,703	84,047,142	92,938,533	102,300,000	111,000,000	120,800,000
Construction Expenditures ($'000)								
A.T.& T.	$920,520	$2,709,844	$7,313,752	$8,483,635	$9,516,000	$10,156,000	$9,900,000	$10,725,000
Others	193,000	571,000	1,665,000	2,053,000	2,325,000	2,500,000	2,367,000	2,555,000
Total	1,113,520	3,280,844	8,978,752	10,536,635	11,841,000	12,656,000	12,267,000	13,280,000

Source: U.S. Independent Telephone Association.

The table above shows the importance in the U.S.A of the A.T.& T. system (otherwise referred to as the "Bell System" - no relation to Bell Canada). Through subsidiary companies, it controls 82% of the telephones in that country, plus it owns the largest telecommunications equipment manufacturing company in the world, Western Electric, and operates the largest and most sophisticated non-government owned research laboratory in the United States, Bell Research Labs. It accounts for over 80% of the local calls made in the U.S.A. and its Long Lines Department accounts for 90% of the long distance traffic in the United States. Furthermore, the Long Lines Department sets the long distance tariffs that are applicable to the entire country. In general, because it has a captive equipment manufacturing operation, A.T.& T. does not represent a large market for outside equipment manufacturers such as Northern Electric, although Northern Electric has sold some equipment to A.T.& T.'s subsidiaries, particularly Pacific Telephone. This, however, could change depending on the results of the attempts by the U.S. Justice Department to break up A.T.& T. into its component companies including a divestiture of Western Electric. In fact, Western Electric itself could be broken up into two independent companies. This is discussed later in this report.

Turning to the independent telephone companies in the United States, these number 1,641 and are located in every part of the country serving almost two-thirds of the telephone exchanges in the country, but nevertheless only accounting for 18% of the number of telephones in operation. They have a total plant investment of about $20 billion compared to A.T.& T.'s plant investment of $83 billion.

The independent companies range from large corporations such as General Telephone & Electronics Corporation, which, after A.T.& T., is the largest holding company in the telephony industry in the U.S.A., serving almost 12 million telephones, to very small telephone companies that serve fewer than 1,000 customers.

A comparison of a number of relevant factors for the independent telephone companies and the A.T.& T. system is as follows:

Table 3

A.T.& T. and U.S. Independent Companies - Statistics, 1974

	A.T.& T.	Independents	U.S. Total
No. of telephones	118,146,000	25,826,000	143,972,000
No. of companies	25	1,641	1,666
No. of exchanges	6,728	11,048	17,776
Total value of plant ($ bill.)	82.7	19.6	102.3
Construction expenditures - 1974 ($ bill.)	10.2	2.5	12.7
Operating revenues ($ bill.)	26.8	4.9	31.7
No. of employees	812,000	158,000	970,000
No. of shareholders	3,612,000	950,000	4,562,000

For 1975, the number of telephones operated by the independents is expected to go to 26,900,000 which would be an increase of 4.2% over 1974. Operating revenues are expected to be approximately $5.4 billion, up 10.2% over 1974, while average revenues per telephone are expected to be about $205.00. Construction expenditures in 1975 are expected to be down by about $200 million to $2.3 billion and the total plant of the independents at the end of the 1975 year is expected to be about $21.4 billion. The average plant per station will be about $796.

Regulation and the Justice Department Action

The recent action by the U.S. Justice Department to break up A.T.& T. into several independent parts could have some profound effects on the telecommunications equipment manufacturing industry. Here we present the background to the Justice Department's action.

In the U.S.A., the interstate telephone industry is regulated by the Federal Communications Commission ("F.C.C."), while activities within individual states are regulated by local public utility commissions; furthermore, in Texas, municipalities also excercise control. With no single agency responsible for the regulation of a giant company such as A.T.& T., the regulation and enforcement processes have been weakened. In essence, A.T.& T. has become so large and the regulatory process has become so diffused that the regulatory agencies have had difficulty in exercising effective control. As a result, the Justice Department recently stepped into the situation and is seeking the breakup of A.T.& T.

Over the past several years, the F.C.C.'s intention plainly has been to increase competition in the telecommunications industry. In 1968, in what is now referred to as the "Carterfone decision", the F.C.C. ruled that the public should be allowed to purchase equipment such as repertory diallers, answering machines, etc., from other sources, i.e. not manufactured or supplied by A.T.& T. or by its subsidiaries and that the public be allowed to attach these terminal devices to Bell's local lines. This was the first step in ending or altering monopolies that the telephone companies historically enjoyed and marked the beginning of the "interconnect" market. It is felt that this and other decisions were caused in part by the deterioration of telephone service in the densely populated areas of the U.S.A., notably New York City, and other east coast areas. This, in turn, was caused by an unprecedented increase in demand for service which was unexpected by the telephone companies, and, therefore, for which they were not prepared. Subsequently, in 1969, "specialized common carriers" were established when the F.C.C. permitted competition for long distance lines and "innovative" services. Then, in 1970, the Commission established an "open sky" policy for the new market of domestic satellite services.

The F.C.C.'s moves toward greater competition in the telecommunications industry have been much less effective than it had hoped because:

- certain markets such as specialized data services turned out to be much less attractive than the F.C.C. had thought,

- A.T.& T. actively opposed the extension of competition (although not in satellites),

- some of the new companies that entered the field ran into financial problems, especially since A.T.& T. cut prices, although the F.C.C. would not allow it to reduce prices by as much as it wanted,

- A.T.& T. refused to connect the long distance facilities of the specialized carriers with its local lines; therefore, the new companies could not offer an end-to-end service.

One of the methods used to control the rate of new product attachments, with the F.C.C.'s concurrence, was to insist that, in order to protect the extremely complex and expensive circuits from problems resulting from the installation of interconnect equipment of either inferior quality or of non-matching electrical characteristics, an interface device be used between private equipment and the telephone network. The fact that the interface equipment was expensive and often not available acted as an effective barrier to certain forms of competition. Now, however, it appears possible that this ruling may be rescinded in the near future; hence the sales of interconnect equipment could grow rapidly at the expense of traditional suppliers, notably Western Electric.

Obviously, the ability to access telephone company subscribers has provided fertile ground for the growth of independent non-regulated competitors. For example, in the important Chicago to St. Louis market, an independent operator, Microwave Communications Inc. (MCI), within less than a year after it set up its service, obtained over 80% of the point to point private line business from Bell and has since captured the remainder. Recently, other companies such as ITT have been granted permission to compete with the telephone companies along other major routes, and the F.C.C. has before it applications to open hundreds of additional routes.

Because of the apparent difficulties that the F.C.C. has had in forcing competition, the U.S. Justice Department stepped in. In September 1973, it served A.T.& T. with a certificate of investigative discovery which is the normal first step to a suit. In November 1974, the Justice Department filed an antitrust suit asking that A.T.& T. be broken up into smaller units. It wants A.T.& T. to divest itself of its manufacturing subsidiary, Western Electric, which itself has sales of over $7 billion a year, and it wants Western Electric itself to be broken up into two or more independent companies.

Apparently, the Justice Department feels that through Western Electric and Bell Telephone Laboratories Inc., both of which are unregulated, A.T.& T. has extended its monopoly to the design, manufacture and sale of telecommunications equipment. In essence, it is suggested that this gives A.T.& T. the power to control the rate at which technology is introduced, and obviously the profits on the manufacture of equipment. It appears that the Justice Department is not yet certain as to what it would like done with Bell Laboratories, which is the largest industrial research lab in the U.S.A. and which can be considered a national resource.

Furthermore, as indicated earlier, the Justice Department is seeking to separate A.T.& T.'s Long Lines Department from A.T.& T.'s 23 operating companies. The Long Lines Department handles the bulk of the interstate long distance service in the U.S.A. and determines the pricing and operating practices for the entire interstate long distance network in the U.S.A. through its contracts for long distance rate services with the independent telephone companies.

The full consequences of a possible breakup of A.T.& T. are unknown at this time. A.T.& T., quite correctly, has advanced the viewpoint that a large regulated monopoly enjoys economies of scale and therefore can offer its subscribers a telephone service of top quality at a low price. On the other hand, its opponents feel that a breakup of A.T.& T. into smaller units would result in greater competition and would remove any impediment to technological innovation.

For Northern Electric, there are two major implications. First, the divestiture of Western Electric would open up the vast A.T.& T. market to outside suppliers and, secondly, the divestiture of Western Electric would result in Western Electric becoming a significant competitor in the market for telecommunications equipment for the independent telephone companies and this could cut into Northern Electric's growing market penetration in that sector. In total, the net effect would likely be positive for Northern Electric with the potential business to be obtained in the A.T.& T. market more than offsetting the extra competition for the independents' business.

Canada

The Canadian situation in many ways is similar to that in the U.S.A. The telephone industry in Canada is dominated by Bell Canada which itself was partially owned by A.T.& T. (although A.T.& T.'s ownership was reduced to a very small position in recent years) until its remaining interest was sold in 1974. Another similarity is that Bell Canada has its own manufacturing operations, Northern Electric, just as A.T.& T. has Western Electric. The major difference is that Northern Electric is far more advanced than Western Electric in terms of independence from its parent company. Furthermore, there has been no pressure by the government for any breakup of Bell. As in the U.S.A., in Canada, part of the telephone industry is regulated by the federal government and part by the provincial governments.

A comparison of the number of telephones in operation gives an indication of the relative size of the Canadian telephone companies.

Table 4

Canadian Telephone Companies - Number of Telephones, 1974

	Number of Telephones ('000)
BELL CANADA GROUP	
Bell Canada	7,519
Maritime Tel.	379
New Brunswick Tel.	304
Newfoundland Tel.	142
Northern Tel.	57
Telebec Ltee.	47
Island Tel.	46
G.T.& E. GROUP	
B.C. Tel.	1,383
Quebec Tel.	198
Okanagan Tel.	84
Alberta Govt.	715
Manitoba Tel.	521
Saskatchewan Tel.	391
Edmonton Tel.	305
Thunder Bay Tel.	70
C.N. Telecom	67
Northern Quebec Tel.	66

Europe

The telephone industry and its suppliers in Europe are influenced by four interacting factors:

1. great pent-up demand,
2. rapid changes in technology,
3. financial constraints, and,
4. the vagaries of politics and erratically changing budgets.

The major problems facing the telephone utilities are the availability and continuity of financial resources for investment in equipment and the non-compatibility of different systems.

In most European countries, telecommunications services are provided by government owned and controlled monopolies, usually as part of the post office (the post, telegraphs and telephones or "P.T.T.'s"). This has resulted in the telephone industry in Europe being subject to political influence which in turn has resulted in telephones being assigned a low priority in capital allocation at the expense of quality and quantity of service. In addition, the post offices, which generally operate at a loss, are often subsidized by the telecommunications services, thereby siphoning off funds that would normally be used for expansion of telephone services. Related to this is the fact that, regardless of 5-year plans, government budgets change substantially from year to year. Thus, telephone utilities in Europe, being subject to yearly budgetary restraints, have difficulty making longer term plans. In a capital intensive, high technology business such as telecommunications, long lead times are common and cut-backs result not just in limited facilities but also in unbalanced systems. In addition, over and above the budgetary problems, because of the strong political influence, the price charged for telephone services has been kept lower than the level at which demand would be met. As a result, the number of subscribers has tended to reflect the supply of telephones.

Furthermore, the P.T.T.'s in the various countries have developed their own independent technical standards based on close working relationships with domestic manufacturers; this has resulted in the European telephone industry being fragmented into a number of separate, almost totally exclusive national markets with a very low level of international trade in telecommunications equipment. Only recently has telephony in Europe begun to develop a few of the characteristics of a single market.

The growth of telecommunications services began to accelerate in the 1960's as a result of the growth in demand and the application of advanced technology. However, the extremely high cost of financing expansion and modernization has acted as a constraint to growth in spite of the evident gap between demand for service and supply and in spite of the differences in quality and quantity of telephone service between Europe and North America. A measure of the difference in the level of telephone services between the two continents is the telephone penetration rate. As shown in chart 5 on page 20, the telephone concentration in North America is 63.9 per 100 population and in Europe it is 17.2 per 100 population. Although Eastern Europe

brings the average down for all of Europe, the Western European penetration is still less than half the level that has been reached in Canada and in the U.S.A. In total, overall progress in Europe is at a moderate pace and capacity constraints in exchange and transmission facilities will continue well into the 1980's.

The telecommunications equipment manufacturing industry in each European country is generally a sideline of the individual companies' basic electronic and electrical engineering activities. Telecommunications equipment manufacturing accounts for approximately 30% of the total companies' sales. Their reliance (except for L.M. Ericsson in Sweden) on the local market makes this portion of their business very vulnerable to changes in political decisions.

The analysis of the telecommunications equipment manufacturing market in Europe is made very difficult by the fact that meaningful statistics are virtually non-existent. Although production statistics are available in varying degrees of detail for most countries, the definitions are not standardized and, as a result, proper comparisons are virtually impossible to make. However, as indicated in the note after table 1 on page 21, a very creditable attempt has been made by "Euro Economics" which is the economic research arm of Eurofinance S.A. whose main shareholders are leading banks in Western Europe, North America and Japan. Euro Economics, in its 1975 report covering the telecommunications equipment market in the seven major countries of Europe, the United Kingdom, West Germany, France, Italy, Sweden, the Netherlands and Belgium, notes that total expenditures by the P.T.T.'s in these seven countries is projected to rise from an estimated $7.4 billion in 1973 to $10 billion in 1980 and $13 billion in 1985 (measured at 1973 prices and exchange rates). Concomitantly, the domestic market is estimated by Euro Economics to increase to $7.9 billion in 1980 and $10.7 billion in 1985 which would be an average growth rate of 8% in real terms.

Euro Economics points out that, because of the impediments to international trade in telecommunications equipment, there will be no significant increase in the proportion of exports or imports.

A summary of the data presented by Euro Economics is shown on the following page.

Table 5

Market Prospects for European Telecommunications Equipment Manufacturing Industries, 1968-1985

($ billions - 1973 rates)(1)

By country of manufacturer	1968	1973	1975	1980	1985	Average growth (% p.a.) 1968-75	1975-85
United Kingdom	$0.56	$0.91	$0.95	$1.70	$2.30	7.8%	9.2%
West Germany	0.85	1.71	1.60	2.50	3.20	9.5	7.2
France	0.40	1.02	1.30	2.50	3.50	18.3	10.4
Italy	0.34	0.70	0.70	1.30	1.90	10.8	10.5
Sweden	0.24	0.41	0.41	0.55	0.70	7.6	5.8
Netherlands	0.13	0.19	0.21	0.32	0.40	7.1	6.7
Belgium	0.14	0.20	0.21	0.32	0.39	8.3	6.4
Total	$2.66	$5.14	$5.38	$9.19	$12.39	10.2	8.7
By main product class							
Exchanges	$1.72	$3.27	$3.38	$5.70	$7.80	10.0%	8.7%
Transmission	0.46	0.87	0.87	1.50	2.00	9.5	8.6
Telex & Telegraph	0.23	0.43	0.53	1.10	1.20	12.7	8.5
Subscriber equipment	0.31	0.58	0.59	0.90	1.40	9.6	9.0
Total	$2.72	$5.15	$5.37	$9.20	$12.40	10.2	8.7

(1) Value of shipments (viz. sales/production) to domestic and export markets at constant prices; exchange rates used for conversion refer to end of 1973.

Source: Euro Economics: Telecommunications Industry in Western Europe - 1975.

The economic importance of the telecommunications equipment manufacturing industry in domestic and export markets for the seven European countries under discussion as calculated by Euro Economics is shown on the following page.

Table 6

European Telecommunications Equipment Manufacturing Industry
Economic Importance: 1973

	Value of Shipments ($ Millions)		No. of Employees ('000)	Shipments as % of GDP	Employees as % total domestic labour force	Value of shipments per employee ($'000)
	Total	Domestic				
United Kingdom	$ 905	$ 805	89	0.6%	0.4%	$10.2
West Germany	1,710	1,360	85	0.5	0.3	20.1
France	1,020	940	61	0.4	0.2	16.8
Italy	695	620	70	0.7	0.4	9.9
Sweden	410	80	20	0.8	0.5	20.5
Netherlands	190	110	9	0.3	0.2	21.6
Belgium	200	110	12	0.5	0.3	16.7

Source: Euro Economics: Telecommunications Industry in Western Europe - 1975.

The relative importance of the various telecommunications equipment categories in Europe is as follows:

Table 7

Relative Importance of Telecommunications
Equipment Categories - Europe: 1973

	Approximate % of Total Production
Switching Apparatus	
Public Telephone Exchanges Private Network Exchanges (PABX's and user-owned Equipment) Telegraph and Telex Exchanges	55%
Transmission Equipment	
Multiplexors Modems Microwave Relays Concentrators	15%
Subscriber Equipment	
Telephone Sets Terminal Equipment for Telex and Data Processing, etc.	10%
Cables	
Coaxial cables Subscriber lines	20%
	100%

Source: Euro Economics: Telecommunications Industry in Western Europe - 1975.

The rapid growth rate in sales in the 1968 to 1973 period in France was a function of the French P.T.T.'s attempts at improving the telephone service. Nevertheless, the penetration level of telephones in France (i.e. subscriber lines per 100 people) is expected to remain the lowest in Europe except for Italy. In the case of Sweden, where the domestic market absorbs only 20% of the production of telecommunications equipment, the increase in sales primarily will comprise exports of components to subsidiary companies in other markets.

In total, equipment sales by manufacturers in the seven countries are projected by Euro Economics to grow by 10.2% per year to $9.2 billion in 1980 and by 8.7% per year to $12.4 billion in 1985. An upturn in demand for telecommunications equipment from the current reduced level is not expected before late 1976 or early 1977. Longer term, the demand for services will ensure that the P.T.T.'s will raise their spending in the 1977 to 1980 period. However, as pointed out by Euro Economics, and with which we concur, the major impetus to growth will occur when the latest sophisticated technical developments have been fully incorporated into the networks. This will likely occur beyond the mid 1980's.

Finally, the relative sizes of the European telephone markets are as follows:

Table 8

Relative Sizes of European Telephone Markets, 1974

Country	Number of Telephones 1974	Per 100 Population	% Private	Average Growth Rate In Number of Telephones 1968-1973
Sweden	4,984,370	61.20	0.0%	4.5%
Switzerland	3,604,034	55.44	0.0%	6.1%
Denmark	2,047,497	39.99	88.2%	5.5%
Austria	4,569,182	35.36	0.0%	7.8%
United Kingdom	19,095,317	34.06	0.0%	7.9%
Norway	1,308,420	32.93	0.1%	5.0%
Finland	1,535,406	32.91	69.0%	8.3%
Netherlands	4,317,006	32.00	0.0%	8.0%
Federal Republic of Germany	17,802,646	28.73	0.0%	9.9%
Belgium	2,503,036	25.72	0.0%	5.9%
Italy	12,611,653	22.86	100.0%	10.0%
France	11,337,000	21.66	0.0%	8.1%
Greece	1,670,132	18.67	0.0%	17.8%
Spain	6,331,474	18.13	100.0%	11.2%
Czechoslovakia	2,354,313	16.09	0.0%	n.a.
German Democratic Republic	2,326,143	13.67	0.0%	n.a.
Portugal	948,003	10.02	0.0%	7.2%
Hungary	968,459	9.27	0.0%	n.a.
Bulgaria	640,842	7.37	0.0%	n.a.
Poland	2,237,603	6.68	0.0%	n.a.
U.S.S.R.	14,260,700	5.68	0.0%	n.a.
Yugoslavia	1,003,550	4.77	0.0%	n.a.
Romania	886,166	4.25	0.0%	n.a.
Turkey	807,294	2.09	0.0%	8.0

A brief discussion of the individual markets follows:

The United Kingdom

In the U.K., all the telecommunications services are operated by the Post Office which is a government owned corporation with its own board of directors and which is accountable to the government through the Secretary of State for Industry. It operates its system with a view to making a profit although the overall investment program continues to be ratified by the government. There are no private operators of telecommunications services in the U.K. except for the Channel Islands. On the other hand, companies, if they have more than 100 lines, may install their own PABX systems which must be supplied by one of the five Post Office approved sources.

The U.K. has relied heavily on use of the Strowger electro-mechanical switching system and has attempted to make a quantum jump from step-by-step technology to electronic switching technology through its use of the TXE-2 and the TXE-4 switching devices. However, it has experienced many problems in this attempted transformation. The electronic systems used currently in the U.K. are not as advanced as those used in other countries since they do not make extensive use of stored program technology. In essence, they use electronics for switching but make only limited use of central processing.

West Germany

The telephone, telex and telegraph services in West Germany are operated by the Deutsche Bundespost which is operated by the Federal Ministry for Research and Technology and for Postal and Telecommunications Services. The West German system is considered second in quality after the U.K., but it is closing the gap rapidly.

France

Of the major countries in Europe, France has lagged the most in the development of its telecommunications system. Although, ironically, France is the only country in the world having a completely electronic switching system in operation, this system covers only 35,000 lines and is being expanded only very slowly. Aside from that, the French telecommunications network is more dependent upon manual switching than most of the other countries in the world with only 82.5% of its subscribers being on automatic switching, compared to 99.6% for the U.K., 99.5% for Canada and 99.9% for the U.S.A. Only Spain with 82.1%, India with 80.5% and Korea with 80.4% among the 37 countries with more than 500,000 telephones, have a lower percentage of subscribers connected to automatic exchanges. Consequently, the French government's sixth 5-year plan* which was promulgated in 1970, allocated FF 39.5 billion for telecommunications equipment contracts between 1971 and 1975.

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* Commisariat Général du Plan: "Rapport du Comité des Etudes à Long Terme, Postes et Télécommunications".

This was subsequently amended upward to FF 41.0 billion. The target was an annual 25% increase in the volume of orders to provide 12 million lines by the end of 1978, an increase from 5 million in 1973. More recently, however, the government's austerity plans have lowered the 25% annual increase target. The real increase in orders in 1975 is expected to be only 5%; thus the goal of 12 million lines by the end of 1978 has been cut back to 10 million.

A more recent announcement in France indicates that the government will double spending over the next two years and has added over $1 billion to the proposed Post Office budget for 1976.

Currently, the objectives for the French telephone system for the next eight years are to:

- increase the number of telephone lines in France to 7 million and reduce installation delays to 15 months in the current year,

- and to increase the number of telephone lines to almost 20 million and reduce installation delays to 15 days by 1981-1982.

If these goals are achieved, France will then have almost caught up with the average telephone density of the United Kingdom and West Germany.

The French telecommunications equipment manufacturing companies are commented on in the section under competition. Briefly, however, it is worth commenting on the fact that the French government's strong support of local participation in the manufacture of telecommunications equipment has resulted in a limit on technological development in France. To counter this, the government recently has encouraged a widening of the suppliers' "clubs". These clubs comprise primarily two organizations which act as liaisons between the P.T.T. and the individual manufacturers. These are SOTELEC (Société pour le Développement de la Technique des Télécommunications sur Cables) and SOCOTEL (Société pour le Développement de la Technique de la Communication dans la Domaine des Télécommunications). Both SOTELEC and SOCOTEL coordinate research among manufacturers and help set specifications and standards. Five manufacturers currently are supplying switching equipment under the auspices of SOCOTEL and also there are five companies that are members of the SOTELEC group.

The French government has encouraged another company, Thomson-CSF, to join SOCOTEL in order to further diversify its sources of supply and to encourage the improvement of the level of technology in France. Consequently, Thomsom-CSF has entered into a number of agreements with Northern Electric under which it will introduce and manufacture in France a number of Northern Electric's products. This is described further on page 47.

Italy

The situation in Italy stands out as being quite different from that in the other western European countries. The Azienda di Stata per i Servizi Telefonici (A.S.S.T.) handles international telephone services between Italy and European and Mediterranean countries as well as long distance lines among the major telephone districts in Italy. A.S.S.T. is an autonomous public corporation which operates the primary networks in the country. Telegraph and telex services, both within Italy and with European countries are under the control of Direzione Centrale Telegrafi (D.C.T.). Both A.S.S.T. and D.C.T. form part of the Ministry of Posts and Telecommunications.

The Societa Italiana per 1'Esercizio Telefonico (S.I.T.) operates, under concession, local telephone services. S.I.T. is a company in which both I.R.I. (the Italian state holding company - Instituto per la Riconstruzione Industriale) and STET (a subsidiary of I.R.I. - Societa Finanziara Telefonica p.a.) have 7.3% and 53.9% of the equity respectively. The intercontinental public telephone system, as well as telegraphy, telex and data transmission services are operated by Itelcable which is a subsidiary of the Italian I.R.I.-STET group while the earth stations for the satellite international communications facilities are operated by Telespazio which is the Italian partner in Intelsat (the International Telecommunications Satellite Corporation is a consortium of 80 nations providing global satellite telecommunications). Microwave links in Italy are provided by R.A.I. which is the Italian state broadcasting company.

All the concessionary companies are subsidiaries of I.R.I.-STET thus giving the government effective control in all matters of telephony.

Sweden

Telecommunications services in Sweden are provided by Televerket which is the telecommunications authority. It is a public enterprise with its own board of directors and is responsible to the Ministry of Telecommunications.

Netherlands

As in other countries, telecommunications services in the Netherlands are provided by the P.T.T. and directed by the Ministry of Economic Affairs. There are no private telephone operators and all equipment connected with the public telephone network must be obtained from the P.T.T.

Belgium

As in other countries, the telecommunications services in Belgium are operated by the Régie des Télégraphes et Téléphones which is a government owned company.

Summary of Telephony in Europe

In summary, European telephony is attempting to improve the level of service available to subscribers, although financial and political constraints continue to restrict progress. The individual national markets are too small to offer economies of scale, yet the outlook for increased trade among the European countries in telecommunications equipment is not great. Furthermore, the problem of incompatability of equipment continues to be as great as ever and presents a strong non-tariff barrier to trade. It also will continue to act as an impediment to the improvement of service. Nevertheless, in spite of the constraints, spending to raise the quality and quantity of telecommunications service in Europe is increasing rapidly and progress in fact is being made. As a result, the European P.T.T.'s have become, in total, the second most important group of buyers of telecommunications equipment in the world.

Competition

The major manufacturers of telecommunications equipment in North America are Western Electric which supplies almost exclusively A.T.& T., the manufacturing subsidiaries of General Telephone and Electronics, i.e. GTE Automatic Electric Limited and GTE Lenkurt Electric Limited (Canada and U.S.A.), manufacturing subsidiaries of ITT, (Canada and U.S.A.) and Northern Electric (primarily in Canada, but expanding in the U.S.A.). In addition, there are hundreds of other manufacturers in North America which manufacture varying portions of the range of equipment available; these include American Telecommunications Corporation, California Microwave Inc., Continental Manufacturing, Farinon Electric, North Electric, Stromberg-Carlson, etc.

In Europe, there are a number of manufacturers, although the prominent company is ITT which is almost twice the size of its nearest rival, Siemens. ITT was founded in 1926 when A.T.& T. in the U.S.A. was forced by the Antitrust Department to dispose of its foreign subsidiaries. ITT subsequently grew through a series of takeovers and in virtually every country in Western Europe it has succeeded in adopting a local appearance.

The country that has attempted the most to minimize the growth of ITT in recent years is France where the government has encouraged other local companies to develop and supply equipment that the French subsidiary of ITT has successfully developed and exported.

A list of the major telecommunications manufacturers is shown in table 9 on the next page while table 10 provides some statistical comparisions.

In Europe, the growth of the telecommunications equipment manufacturing companies depends primarily on the growth of local economies and the investment plans of the local telephone utilities, since they are generally involved only in local markets with very little export business being done. The major exception is L.M. Ericsson of Sweden whose exports account for about 80% of its total business.

Table 9
Major Telecommunications Equipment Manufacturers

	Product categories				
	Telephone Sets	P.B.X.	Switching	Micro-wave	Modems
Western Europe					
Austria	Kapsch Siemens ITT Philips	ITT Philips	Kapsch Siemens ITT	ITT	ITT
Belgium-Luxenbourg	ITT GTE (ATEA)	ITT GTE (ATEA)	ITT GTE (ATEA)	ITT	ITT
Denmark	L.M. Ericsson Automatic AS ITT (Standard) Storno	L.M. Ericsson ITT (Standard)	L.M. Ericsson ITT (Standard)	L.M. Ericsson ITT (Standard)	L.M. Ericsson ITT (Standard)
France	Thomson-CSF ITT (LMF) ITT (CGCT) ITT (LIT) L.M. Ericsson CIT TRT	ITT L.M. Ericsson	Thomson-CSF ITT (LMT) ITT (CGCT) ITT (LIT) L.M. Ericsson CIT TRT	ITT L.M. Ericsson	ITT L.M. Ericsson
Germany	ITT Siemens GIE (Bosse) AEG-Telefunken	ITT Siemens GIE (Bosse) AEG-Telefunken	ITT Siemens AEG-Telefunken	ITT Siemens AEG-Telefunken	ITT Siemens AEG-Telefunken
Greece	ITT Siemens Philips	ITT Siemens Philips	ITT Siemens Philips	ITT Siemens Philips	ITT Siemens Philips
Italy	ITT (FACE) LME (FATME) Siemens GTE (AE/ML)	Siemens GTE (AE/ML)	ITT (FACE) GTE (AE/ML) Telettra LME (FATME) Siemens	GTE (AE/ML) Siemens	Siemens
Netherlands	Philips ITT (Standard) L.M. Ericsson	Philips ITT (Standard) L.M. Ericsson	Philips ITT (Standard) L.M. Ericsson	Philips ITT (Standard) L.M. Ericsson	Philips ITT (Standard) L.M. Ericsson
Norway	L.M. Ericsson ITT AS Electric	L.M. Ericsson ITT AS Electric	L.M. Ericsson ITT AS Electric	L.M. Ericsson	L.M. Ericsson ITT
Portugal	Plessey ITT (Standard) Siemens (Proton) Gustav Ring	Plessey ITT (Standard)	Plessey ITT (Standard) Telettra Siemens (Proton) Gustav Ring	Plessey ITT (Standard)	Plessey ITT (Standard)
Spain	ITT GTE (Invesel) L.M. Ericsson	L.M. Ericsson ITT	L.M. Ericsson ITT	ITT GTE (Invesel) L.M. Ericsson	L.M. Ericsson ITT
Sweden	L.M. Ericsson Televerket ITT (Standard)	L.M. Ericsson Televerket ITT	L.M. Ericsson Televerket ITT	L.M. Ericsson Philips Televerket ITT	L.M. Ericsson
Switzerland	Hasler Albiswerke ITT (Standard) L.M. Ericsson	L.M. Ericsson Hasler	Hasler Albiswerke ITT (Standard) L.M. Ericsson	L.M. Ericsson	L.M. Ericsson
United Kingdom	ITT L.M. Ericssen Plessey (ATE) GEC-AEI Marconi Mullard (Pye)	ITT L.M. Ericsson Plessey (ATE) GEC-AEI Marconi Mullard (Pye)	ITT L.M. Ericsson Plessey (ATE) GEC-AEI Marconi Mullard (Pye)	ITT L.M. Ericsson Plessey (ATE) GEC-AEI Marconi Mullard (Pye)	ITT L.M. Ericsson Plessey (ATE) GEC-AEI Marconi Mullard (Pye)
North America					
Canada	Northern Electric AEI Tele-communications Ltd. GTE ITT	Northern Electric GTE AEI ITT	Northern Electric GTE AEI	Northern Electric Farinon Raytheon Collins GTE	Northern Electric E.S.E. Ltd. GTE
U.S.A.	Western Electric Plantronics ITT American Tele-communications Corporation	Western Electric Stromberg-Carlson ITT Farinon Electric	Western Electric Stromberg Carlson North Electric Plantronics Tele Science GTE Automatic	Western Electric ITT GTE Lenkurt California Microwave Farinon Electric	Western Electric ITT

Table 10

Telecommunications Equipment Manufacturers - Statistics

Country	Company	Sales	Income	No. of Employees
U.S.A.	Western Electric	$7.4 billion	$311 million	119,000
	GTE Automatic Electric	$700 million (telecommunications equipment sales)	$42 million	18,183
	General Cable Corp.	$519 million	$27.1 million	6,700
	Farinon Electric	$36.6 million	$2.6 million	977
	Plantronics, Inc.	$27.1 million	$3 million	786
	American Telecommunications Corp.	$16.1 million	$922,000	505
	Telesciences, Inc.	$14.3 million	$2.1 million	216
	California Microwave Inc.	$8.5 million	$313,000	283
Canada	Northern Electric	$970.7 million (1974)	$53.8 million	26,147
	GTE Automatic Electric (Canada)	$116.5 million	$5.8 million	1,839
	ITT Canada Limited	$51 million (1973)	$3.6 million	1,500
	Canadian Marconi	$49 million	$3.4 million	n.a.
	GTE Lenkurt Electric (Canada) Limited	$36.9 million (1974)	$2.3 million	1,041
	A.E.I. Telecommunications (Canada) Limited	$7.2 million (1973)	$648,000	200
United Kingdom	General Electric Company Limited	$3.4 billion	$171 million	n.a.
	British Insulated Callender's Cables Limited	$1.8 billion	$51.3 million	57,000
	The Plessey Company	$955 million (1974)	$52 million	n.a.
West Germany	Siemens A.G.	$6.9 billion	$20.2 million	309,000
	AEG - Telefunken	$4.2 billion	(loss $265,000)	170,400
Sweden	L.M. Ericsson	$1.5 billion (export sales: $1.2 billion)	$48 million	80,600
France	Cie Generale d'Electricite (member of CGE Group)	$4.2 billion	$17.6 million	132,000
	Thomson-CSF	$806 million	$14.4 million	45,000
	C.I.T.-Alcatel (member of CGE Group)	$522 million	$27.8 million	14,700
	Société Anonyme de Télé-communications	$192 million	$4.5 million	5,106
Netherlands	Philips Industries N.V.	$9.9 billion	$286 million	412,000
Japan	Hitachi	$6.1 billion	$119.5 million	144,863
	Nippon Electric Company Ltd.	$1.5 billion	$17.9 million	60,118
	Fujitsu	$620 million (1973)	$50 million	28,500
	Oki Electric Industry Company Limited	$391 million	$10.6 million	14,831

In virtually all sectors of telecommunications equipment, markets tend to be national and local, particularly in Western Europe. Thus, the basic components such as telephone sets, cable, and the simpler PBX's are manufactured in virtually every European country to their own standards for the local market. At the high technology end, particularly in switching and transmission equipment, competition is severe and more international. In switching, as explained later in this report, Northern Electric has developed the advanced and sophisticated SP-1 while competing products include the #1 ESS and #2 ESS produced by Western Electric, but used only by A.T.& T., the Metaconta produced by ITT in France and which has been sold internationally, including one in Las Vegas, U.S.A., and the 1EAX by G.T.& E. In P.A.B.X., one of the new entries in the business is IBM with its 3750 which is produced in Europe.

NORTHERN ELECTRIC OPERATIONS

Before analysing the outlook for Northern Electric's sales and profits, it is important to comment on its operations, i.e. products made, subsidiaries, size of plants and international activities.

Equipment Manufactured

The five major categories into which telecommunications equipment may be grouped and in which Northern Electric is active are:

1) subscriber apparatus,

2) business communications systems,

3) central office switching equipment,

4) wire and cable, and,

5) transmission equipment.

In most of these categories, Northern Electric has a number of proprietary products that are enjoying an excellent response from telephone utilities in Canada and the U.S.A. In 1969, proprietary products accounted for only 6% of sales and by 1974 this had risen to 40%. The Company itself has stated that by 1976, about 60% of sales will be of proprietary products and that this percentage will rise further.

A summary of these categories is shown in table 11 on the following page. A more complete description follows.

1. Subscriber Apparatus

In this category, Northern Electric has developed the Contempra telephone - a modern streamlined telephone with the dialling apparatus in the hand-piece, the Centurion public coin telephone that is extremely sturdy and, as its name implies, is capable of withstanding attack from vandals, etc., and the Companion hands free unit speaker phone for business and residential use. In addition, Northern Electric produces the normal dial, push-button phone (touch-tone) and key (multiline) telephones.

Although these products represent the end result of substantial research and development, and are enjoying very favourable public response, they are at the low end of the spectrum in terms of sophistication of technology, and similar products have been developed by competitive equipment manufacturers. In some cases, the products are almost identical, notably in the case of the Contempra.

Table 11

Northern Electric - Product Categories

Products	Sales in 1974 $ Millions	% of Total	Description	Characteristics	Northern Electric Product
Switching	$314	32.3%	Complete range of electro-mechanical and stored program controlled systems.	Sophisticated systems, high technology, heavy R & D expenditures, long planning intervals, major investments by telephone companies.	SP-1
Wire & Cable	$191	19.7%	Broad range of products from small single wires to large high capacity, multi-circuit cables.	Capital intensive, relatively low technology, highly competitive, generally short lead times, broad range of value of shipments, highly raw materials intensive, subject to commodities price fluctuations.	
Business & Residential Apparatus	$181	18.6%	Telephone sets, speaker units, electronic answering equipment, automatic diallers.	Subscriber equipment: mass production, relatively short and inexpensive development cycles, broad international manufacturing.	Contempra, Centurion payphone, Companion hands-free phone.
				Business equipment: very sophisticated equipment, relatively long development cycles, reasonably short delivery times.	Logic 10 button phone, Pulse P.A.B.X., SL-1 P.A.B.X.
Transmission	$103	10.6%	Microwave radio, analogue and digital carrier and multiplex systems, voice frequency systems.	Long lead times, broad range of sophistication and technology, broad international manufacturing.	MA-5 Multiplex, RA-3T4 Microwave, LD-4 Digital Transmission Cable.
Non-Company manufactured products	$158	16.3%	A broad range of electrical, electronic and industrial products, comprising more than 15,000 products from over 200 manufacturers.	The Company acts as distributor and wholesaler of goods to electrical contractors and to the manufacturing industry. Low technology; immediate delivery; inventory intensive. There are more than 120 companies in the field and Northern Electric has over 13% of the market.	

2. Business Communications Systems

For business communications, Northern Electric produces analogue and digital data systems, multi-line key telephone and intercom systems, switchboards and electro-mechanical and electronic P.A.B.X. systems.

Specific Northern Electric developments and trade marks include the Logic 10 modern, multi-line business telephone, and the Pulse 80, Pulse 120 and SL-1 E.P.A.B.X.'s which are private automatic branch exchanges, i.e. they are switching devices located in a business office or plant and enable individual telephones within the business to communicate through intercom with one another and to communicate with outside telephones. The Pulse E.P.A.B.X.'s are fully electronic but not software controlled. The Pulse 80 provides switching facilities for up to 80 lines (i.e. up to 80 telephones within the business) and the Pulse 120 has facilities for up to 120 lines. The SL-1 which is being commercially introduced at the end of 1975 provides switching facilities for 100 - 7,600 lines and uses a digital network with central processor control instead of wired logic. Thus, it is the first member of a new generation of switching systems.

The business communications systems category of telecommunications equipment represents a higher level of technology and sophistication than subscriber apparatus. All the major telecommunications equipment manufacturers produce products similar to the Pulse switching systems and while Northern Electric has taken the lead in introducing time division P.A.B.X.'s, most major telecommunications equipment manufacturers are now planning similar products.

3. Central Office Switching Equipment

This category is the highest technology portion of the switching business and in this field, Northern Electric has developed sophisticated products that have met with very favourable response. It also produces the traditional step-by-step switching systems, crossbar switching systems and the more advanced SP-1 family of electronic switching systems.

Although the trend since the early 1950's has been to the increasing use of automatic crossbar switching, utilities are still using, although to a declining extent, the original step-by-step equipment. To give an example of this, the breakdown of switching equipment by type of exchange for Bell Canada, Northern Electric's largest customer, is shown below:

Table 12

Relative Importance of Exchange Types
Bell Canada, 1970-1974

	1970		1972		1974	
	Telephones Serviced by Exchanges ('000)	% of Total	Telephones Serviced by Exchanges ('000)	% of Total	Telephones Serviced by Exchanges ('000)	% of Total
Step-by-step exchanges	3,984	66.3%	4,133	61.3%	4,075	54.2%
Crossbar exchanges	1,957	32.6%	2,443	36.2%	2,973	39.6%
Electronic switching exchanges	58	1.0%	163	2.4%	469	6.2%
Other exchanges	8	0.1%	3	0.1%	2	-
Total	6,007	100.0%	6,742	100.0%	7,519	100.0%

Step-by-step and crossbar switches are very well known technologies and are produced by most manufacturers of telecommunications equipment. Electronic switching is a recent development and only the large manufacturers of telecommunications equipment have the sophisticated expertise to develop, produce and install this new generation of equipment. Northern Electric's entry in this category is the SP-1 central processor controlled stored program electronic switch.

From the date of the first order for the SP-1 in 1969, to June 30, 1975, the total number of units ordered (all in North America) was 131 which, when they are all in operation, will service over 1 million lines; 60 of these offices are already installed, servicing over half a million lines. The total value of the number of units ordered was $368 million and the open order at June 30, 1975, amounted to approximately $187 million.

Competitive products to the SP-1 are manufactured by Western Electric (#1 ESS and #2 ESS) and G.T.& E. (#1-EAX and #2-EAX) in the U.S.A., ITT in France (the Metaconta) Philips of Holland (the PRX), L.M. Ericsson of Sweden (AKE), Siemens (EWS) in Germany, and by Plessey (the TXE-2 and TXE-4) in the U.K.

The Western Electric #1 ESS and #2 ESS, respectively, are large and medium size switching systems that can handle a large number of lines. Northern Electric manufactured and installed 11 of the #1 ESS in Canada in the mid and late 1960's. The SP-1 developed by Northern Electric covers a wide size range. It can be used economically in small installations and can also be used in large installations by combining two or more units. The first order for the SP-1 was in 1969 and the first unit was placed in commercial service in 1971.

The #1 EAX produced by G.T.& E. in the U.S.A. is somewhat less flexible than the SP-1 because it uses more wired logic technology and less computer processor controlled technology than the SP-1.

The Metaconta was developed by ITT in France and Belgium and is produced in those two countries as well as in Spain. It is in limited use in France and has been converted for export to other European countries. In addition, one Metaconta has been exported to the U.S.A. and is now in operation in Las Vegas, Nevada. The Metaconta uses either a reed relay glass encapsulated switch or a mechanical switch, whereas the SP-1 uses a miniature electro-mechanical crossbar switch called the Minibar.

The other competitive switches all use varying degrees of stored program central processor systems.

The Northern Electric SP-1 is a complete family of switching systems covering the full range of telephone company requirements. It is fully compatible with the entire North American switching network.

The stored program control provides complete flexibility; when new features are introduced, changes can be effected simply by altering the stored program, thereby minimizing the need for additional hardware and wiring.

The SP-1 is designed especially for ease of maintenance. It has an automated fault detection system that informs a central office of the problem and of the alternative switching routes that are being used. In North America, Northern Electric,

from a central location in Ottawa can monitor all the SP-1's that have been installed without disturbing their operation. The SP-1 is designed to achieve a degree of reliability measured in terms of less than two hours downtime in 40 years.

The SP-1 toll system has capacity to support in excess of 4,000 working incoming trunk lines under average busy hour or busy season condition as a single unit and over 12,000 lines in the large system configuration.

The SP-1 provides centrex services plus automatic forwarding of incoming calls to another number (call forwarding), abbreviated dialling to frequently called numbers (speed calling), three way calling (i.e. a third party can be dialled and added to an existing conversation), call waiting (i.e. during a telephone conversation, a subscriber can receive a signal indicating that a call is waiting, answer it and return to the original call by a simple switchhook operation).

In essence, the SP-1 is an automatic semi-electronic switch; because it uses Minibar switches, it is not considered fully electronic. The next step will be the development of fully electronic time division digital central office switching systems. Northern Electric is currently working on the development of a digital switch and will have one available before the end of the decade.

Other manufacturers are also attempting to develop processor controlled time division switching systems, including Philips which is expected to have one available in 1977 (the TT-300), ITT and Western Electric. The #4 ESS digital switch of Western Electric will be a very large toll time division switch; it is currently being tested at the A.T.& T. Long Lines office in Chicago and is scheduled to be put into operation in six U.S. cities (Springfield, Chicago, Los Angeles, Cleveland, Orlando and Tampa) early in 1976. It will be the world's largest switching machine, being capable of handling 350,000 calls per hour.

In new installations, telephone utilities are expected to concentrate on the use of fully electronic time division switches, once they have been introduced and are in trouble free operation. The current generation of semi-automatic electronic switches, such as the SP-1, will still be produced since they will be needed for the expansion of existing installations; this will be an extension of the situation as it currently exists, i.e. Northern Electric is still producing step-by-step and crossbar switches for limited expansion of existing installations while the new generation of equipment is being produced and sold for large new installations.

4. Wire and Cable

Northern Electric produces a broad range of power cables, telephone wires, coaxial cables, pulp-insulated exchange cables and polyethylene insulated cables.

In this group, Northern Electric has a number of trade marks and produces cable to fixed specifications.

5. Transmission Equipment

In this category, Northern Electric produces analogue and digital carrier equipment, analogue and digital multiplex equipment, microwave radio systems, communications satellite systems and voice frequency equipment and systems.

Its outstanding development in the field of transmission equipment is its LD-4 cable system which is one of the very first long distance high capacity digital transmission systems to be put in service anywhere in the world. It is currently in operation between Montreal and Ottawa and will be in operation in the Montreal-Ottawa-Toronto route by the middle of 1976.

In the LD-4, there are 12 coaxial cables plus 30 signal wires wrapped into a cable only about 3 inches thick carrying 4,032 individual conversation pulses in each tube. There are five tubes in each direction (i.e. the signals in one direction go along one tube and in the other direction along another) plus two spares carrying in total up to 20,162 conversations. It is buried in 6,000 feet repeater sections. The voice signals are reduced to a stream of pulses, at a rate of about 274 million per second and at the end of each 6,000 feet, there is a repeater station which regenerates the signals and removes any noise that may have appeared. The repeaters use thick film, hybrid integrated circuits.

Although the cables are normally expected to last about 40 years and the associated electronic equipment about 20 years, the repeaters used in the LD-4 are designed to work, on average, for 100 years without failure. They are powered by a high voltage current sent down the same coaxial cables that carry the voice signals.

The LD-4 is monitored continuously at each of its repeater sites and if a problem arises, within a few thousandths of a second, service can be switched from one of the operating coaxial cables to one of the spares.

The LD-4 system provides high capacity, accurate and reliable communication at a relatively low cost. Furthermore, it is very flexible since it can simultaneously transmit several different types of communications, i.e. voice, television, data, teletype, etc.

Products Distributed

In 1972, Northern Electric reorganized its distribution division and transformed it into a wholly owned subsidiary, NEDCO Limited. Subsequently, NEDCO acquired control of Zenith Electric Supply Limited. NEDCO distributes a broad range of electrical products to local wholesalers for ultimate sale to electrical contractors, builders, etc. In 1974, $157.9 million or 81.4% of NEDCO's sales of $194.4 million were of non-Northern Electric manufactured products. This portion of Northern Electric's business is dependent to a great extent on housing starts, and, therefore, varies accordingly.

Plants

Northern Electric operates 33 plants and warehouses, totalling 5.6 million sq.ft. of which approximately 1.9 million sq.ft. are leased, located in eight provinces in Canada. The major plants owned and leased are listed below:

Owned	Sq.Ft.
Cable - Lachine, Quebec	1,000,000
Switching - Bramalea, Ontario	750,000
Cable - Kingston, Ontario	500,000
Telephone sets - London, Ontario	400,000
Transmission - St. Laurent, Ontario	250,000
Leased	
Shearer Street - Montreal, Quebec	600,000
Laurentien - Montreal, Quebec	300,000

In addition, Northern Electric has assembly and manufacturing facilities in the U.S.A. with a total plant space of 345,000 sq.ft. of which 145,000 is leased and sales offices in various part of the U.S.A. Also, the Company has just announced the purchase of a small manufacturing plant in Nashville, Tennessee, U.S.A. at a price of $1.5 million. Other subsidiaries have plants in Turkey, Ireland and Malaysia, totalling 81,000 sq.ft. of which 50,000 sq.ft. are owned and the remainder leased. Furthermore, the Company is represented through agencies and distributors in various parts of the free world.

Northern Electric's distribution subsidiary, NEDCO, operates 48 warehouses and sales offices across Canada in 41 cities, occupying a total of about 880,000 sq.ft. of which 191,000 sq.ft. are owned by the Company.

The Company has been phasing out its older, less efficient plants and has been concentrating on the construction and operation of new modern plants. This is continuing, and recently the Company entered into an agreement to sell its Shearer Street plant in Montreal while maintaining a small part of it under lease for up to 10 more years.

International Operations

While maintaining its sales to Bell Canada as the base of its operations, Northern Electric, in the mid 1960's, began to expand internationally by supplying equipment to Nigeria and by setting up a 51% owned subsidiary in Turkey with the Turkish P.T.T. as partner to manufacture in that country standard equipment such as telephone sets and crossbar switches. On both the Nigerian and Turkish ventures, Northern Electric, initially, lost money but gained considerable experience in international dealings. Subsequently, over a period of two years, Northern Electric wrote

down its Turkish investment to zero; however, this subsidiary is now operating profitably, in part owing to the signing of a new contract with the PTT providing for a greater volume at higher prices.

In 1972, Northern Electric established a wholly owned U.S. subsidiary, Northern Telecom Inc. ("N.T.I.") to manufacture and distribute Northern Electric's products in the U.S.A. Sales of this subsidiary in 1972 were $26.9 million, and had risen to $91.1 million in 1974. N.T.I. currently operates five plants in the U.S.A. and has sales offices throughout that country. Furthermore, a research and development laboratory has been established in Palo Alto, California as part of Bell Northern Research.

In Europe, Northern Electric has set up a head office in Amsterdam for the sale of its products in Europe, and it has a plant in Ireland, producing basic components for sale on the continent.

The most important development to date in the Company's attempt at entering the European market is the agreement signed with Thomson-CSF in France. This is discussed below.

The Northern Electric - Thomson-CSF Agreement

Because of its concern about its dependence on two major suppliers, the French government has encouraged a third company, Thomson-CSF, to enter the SOCOTEL club by supporting an association with a foreign manufacturer. After having made contact with other companies, including Siemens and various Japanese groups, Thomson-CSF has associated itself with Northern Electric.

It must be realized, however, that there is a fundamental difference of opinion between the French government and telecommunications experts in France. The major problem is that the government wants to develop additional switching systems in order to increase competition and to minimize its dependence on the two major suppliers, CIT Ericsson and LMT-ITT. On the other hand, the technicians are aware of the problems inherent in the introduction of a third switching system.

As discussed earlier in this report, Northern Electric has developed a very efficient and viable switching system called the SP-1. Thus, the three agreements between Northern Electric and Thomson-CSF cover 1) the manufacture in France of the SP-1, 2) the exchange of technical information and, 3) the distribution of additional Northern Electric products by Thomson-CSF in France.

The agreement on the SP-1 gives Thomson-CSF the right to manufacture the product in France and to sell it in any country in the world outside of North America and Japan.

The results of these agreements cannot be forecast with any degree of accuracy, i.e., it is not certain whether Thomson-CSF will be able to get government orders and secondly, if Thomson-CSF is successful in getting orders, the importance for Northern Electric is unknown. At the very least, Northern Electric will be receiving royalty payments, which in the current fiscal year, will amount to $500,000. After 1977, the agreements could start producing revenues for Northern Electric.

Research and Development

Northern Electric maintains the largest independent research laboratories in Canada; in 1974, it spent $44.1 million on research and development, mainly ($26.5 million) through its 49% owned subsidiary, Bell Northern Research ("B.N.R.") but also to a lesser extent ($17.6 million) through its own laboratories in Montreal and Toronto. Bell Canada owns the remaining 51% of B.N.R.; B.N.R.'s total spending in 1974 was $49 million. The sustaining research and development is done by Northern Electric and the strategic research and development is done by B.N.R. In addition, Bell Canada does a small amount of research and development itself.

Northern Electric's sustaining research and development is done through its Manufacturing Research Centre ("M.R.C.") which was established in May, 1975, to explore and develop new manufacturing techniques. It employs 40 people. In addition, M.R.C. has a subsidiary research organization, the Manufacturing Devices Laboratory that employs 30 people.

B.N.R. was established in 1971 in order to consolidate the research efforts of Northern Electric and of Bell Canada. As indicated, it is 51% owned by Bell Canada and 49% owned by Northern Electric and it operates research and development laboratories, primarily located in Ottawa, although there is a smaller facility located in Palo Alto, California. B.N.R., in total, employs approximately 1,700 people.

B.N.R.'s research encompasses a broad range of disciplines, from basic technology to systems design.

B.N.R. has a number of credits already to its name, including the Contempra and Logic 10 telephone sets, the electret microphone, the miniature crossbar switch, the SP-1 stored program controlled electronic telephone switching system, the Pulse electronic P.A.B.X., the RA-3 microwave radio system, the LD-4 digital cable system, which is designed to carry 20,000 voice messages, Logiflex, a computer aided design system for integrated circuits, charged coupled devices and the new SL-1 business communications system.

Northern Electric conservatively accounts for its research and development expenditures by writing off all research and development costs in the year in which they are incurred.

Diversification and Acquisitions

Northern Electric's recent major move to integrate vertically through the establishment of Microsystems International Limited and its major move to expand through the acquisition of Dictaphone Corporation of the U.S.A. proved to be unsuccessful.

Microsystems International Limited

In 1969, Northern Electric, while it was under the control of its previous management, with federal government assistance and support, formed a separate subsidiary company, Microsystems International Limited, to establish in Canada a manufacturing presence in the high technology semi-conductor and integrated circuits field. For a number of reasons, this venture was unsuccessful and was finally closed down in 1975. The reason for the failure included the depressed world market for semi-conductors and difficulties in the manufacturing process. When it finally closed down, Northern Electric will have absorbed a total of about $35 million in losses before any tax recovery and will have a tax loss carry forward of approximately $45 million which it will apply against the profits of its distribution subsidiary, NEDCO.

The table below shows the effects of Microsystems on Northern Electric's sales and earnings for the past five years and for the first half of the current and previous years.

Table 13

Effect of Microsystems International Limited on Northern Electric's Sales and Profits, 1970-1975

($'000)

	Years ended December 31					Six months ended June 30	
	1970	1971	1972	1973	1974	1974	1975
Sales as reported	$563,611	$576,296	$534,313	$612,821	$970,711	$459,977	$546,151
Less: Sales of discontinued operations	228	1,542	7,843	15,951	23,712	14,012	4,850
Sales of continuing operations	$563,383	$574,754	$526,470	$596,870	$946,999	$445,965	$541,301
Net earnings from continuing operations	10,274	16,479	22,828	38,071	62,158	30,523	40,975
Discontinued operations (net of minority interest):							
Loss from operations of discontinued business	5,249	3,868	2,533	6,041	8,405	1,690	1,709*
Loss of winding-down of discontinued business (net of income taxes of $2,100)	-	-	-	-	-	-	2,723
	5,249	3,868	2,533	6,041	8,405	1,690	4,432
Net earnings as reported	$5,025	$12,611	$20,295	$32,030	$53,753	$28,833	$36,543
Earnings per Common Share before extraordinary items:							
From continuing operations	$0.44	$0.70	$0.98	$1.61	$2.38	$1.17	$1.55
From discontinued operations (losses)	$(0.23)	$(0.16)	$(0.12)	$(0.26)	$(0.33)	$(0.07)	$(0.17)
Net earnings as reported	$0.21	$0.54	$0.86	$1.35	$2.05	$1.10	$1.38

*Net of income taxes of $1,131,000.

Dictaphone Corporation

On September 24, 1974, Northern Electric made an offer to purchase for $12 cash per share all the shares of Dictaphone Corporation, which is a U.S. company listed on the New York Stock Exchange. The management of Dictaphone Corporation strongly opposed the acquisition and subsequently Northern Electric withdrew the purchase offer. As a result of this unsuccessful takeover, a stock brokerage firm in New York instituted a class action against Northern Electric alleging misstatements and omissions in the soliciting material and filings with the S.E.C. The damages sought are not less than $3 million. This has not been resolved.

The attempt at acquiring Dictaphone Corporation indicates the thinking of management with respect to acquisitions. Although further acquisitions are not planned currently, future moves in this direction can be expected.

Management

The top management of Northern Electric has undergone a complete change over the past five years, beginning with the appointment of Mr. John C. Lobb as president of the Company in June 1971; he is currently chairman of the board and chief executive officer. Mr. Lobb, prior to his appointment at Northern Electric, was a partner of Donaldson, Lufkin & Jenrette, which is a U.S. investment banking firm, and prior to that, he had been president and chief executive officer of Crucible Steel Corporation and previously executive vice president of ITT. The president of Northern Electric is Mr. Walter F. Light who was brought into Northern Electric in 1974; previously he had been executive vice president of Bell Canada. A summary of the top management is as follows:

Name	Position
John C. Lobb	Chairman and Chief Executive Officer
Walter Light	President and Chief Operating Officer
C.G. Millar	Executive Vice-President, Operations
J.G. Stark	Senior Vice-President, Finance
W.A. Thompson	Senior Vice-President, Administration
K.H. Woodley	Group Vice-President, Subscriber Equipment,
E.O. Bridges	Group Vice-President, Switching

Labour

At December 31, 1974, Northern Electric and its subsidiaries employed a total of 26,147 employees of which approximately 17,000 were unionized. Of this, approximately 3,500 were salaried and 13,500 were hourly workers. In essence, approximately 20% of the unionized employees are salaried and 80% are hourly. The Company experienced a series of strikes in 1973 following which the existing labour contracts were signed. Approximately 12,000 of the Company's unionized workers will have their contracts coming up for renewal at the end of February, 1976 and the rest will come up for renewal over the following two or three months. The major unions involved are the C.U.C.W. with approximately 6,000 members, and the U.A.W. with approximately 5,000 members. In Canada, all the plants are unionized whereas in the U.S.A. only one small plant, located at Port Huron, Michigan, is unionized. In view of the fact that the wage rates paid by Northern Electric to its employees in Canada are significantly greater than those paid in the U.S.A., a firm position by the Company can be expected to be taken during the negotiations. Thus, the likelihood of one or more strikes in 1976 cannot be ruled out, although the Canadian federal government's anti-inflation moves, if they are successful, will be of assistance in achieving a more reasonable settlement than might otherwise be the case, possibly without any strikes occurring.

NORTHERN ELECTRIC COMPANY, LIMITED

FINANCIAL ANALYSIS

Sales

As indicated earlier, Northern Electric derives its sales from Canada, the U.S.A., Europe and, to a small extent, Asia Minor and Africa. The geographical breakdown of sales over the past three years was as follows:

Table 14

Northern Electric Sales - Geographical Breakdown, 1972-1974

	1972	1973	1974
Canada	90.98%	87.50%	86.65%
U.S.A.	5.03%	7.76%	9.39%
Overseas	4.12%	4.90%	4.12%
Less B.N.R. outside sales	(0.13%)	(0.16%)	(0.16%)
Total	100.00%	100.00%	100.00%

As shown in the table above, the relative importance of Northern Electric's Canadian sales is decreasing while the relative importance of its U.S. sales is rising rapidly. Thus, while the very important base of Northern Electric's operations is its Canadian sales, its U.S. sales are providing the growth potential.

In Canada, the recent trend of capital expenditures by telephone utilities (which is the prime determinant of Northern Electric's sales) has been as shown in table 15 on the following page.

Table 15

Capital Expenditures by Canadian Telephone Utilities
1971-1974

($'000)

	1971	1972	1973	1974
Canadian telephone utilities capital expenditures	$816,327	$893,222	$1,031,948	$1,460,000
% Increase	n.a.	9.4%	15.5%	41.5%
Northern Electric's sales in Canada	n.a.	$485,437	$535,284	$839,595
As % of Total	n.a.	54.3%	51.9%	57.5%

In the U.S.A., capital expenditures by the telephone utilities totalled an estimated $11.8 billion in 1973 and $12.8 billion in 1974. Thus, Northern Electric's U.S. sales of $47.5 million in 1973 and $91.1 million in 1974 represented a market share of 0.4% and 0.7% respectively. Recent data on capital expenditures by U.S. telephone utilities are as follows:

Table 16

Capital Expenditures by U.S. Telephone Utilities,
1959-1976

($'Millions)

	1959	... 1964	... 1969	1970	1971	1972	1973	1974	1975(est.)	1976(est
Capital spending:										
A.T.& T. group	$2,249	$3,519	$5,875	$7,314	$7,728	$8,484	$9,516	$10,280	$9,900	$10,800
Independents	512	792	1,595	1,688	1,999	2,100	2,325	2,500	2,300	2,400
Total	$2,761	$4,311	$7,470	$9,002	$9,727	$10,584	$11,841	$12,780	$12,200	$13,200

Total sales of telephone and telegraph apparatus in the U.S.A. were $3,851.3 million in 1972 and $4,045.5 million in 1973. These comprised sales of switching equipment and other equipment as shown in the table on the following page.

Table 17

U.S. Sales of Telephone and Telegraph Apparatus
1972-1973

($'Millions)

	1972	1973
U.S. sales of telephone & telegraph apparatus		
Switching	$1,515.0	$1,689.4
Others	2,336.3	2,356.1
Total	$3,851.3	$4,045.5
Northern Electric's U.S. sales	$26.9	$47.5
As % of Total	0.7%	1.2%

Thus, even when only the sales of equipment are considered, (i.e. excluding spending by the utilities on land and buildings) Northern Electric's market share in the U.S.A. is still low.

However, the statistics for the entire U.S. market and the indicated penetration by Northern Electric are misleading since the portion of the U.S. market most open to Northern Electric is that of the independent telephone companies. The independents total 1,641 (as of the end of 1974) but serve only 18% of the total number of telephones in the U.S.A., while the remaining 82% of the telephones in the U.S.A. are operated by the operating subsidiaries of A.T.& T.

Furthermore, included in the listing of independent companies is G.T.& E., which accounts for 47% of the number of telephones served by the independent telephone companies in the U.S.A. and which, like A.T.& T., has its own manufacturing subsidiaries.

Thus, the prime market for Northern Electric in the U.S.A. comprises the independent telephone companies serving 14 million telephones which represents 10% of the total U.S. market, and which compares to the total of 12 million telephones in operation in Canada. Although G.T.& E. has its own manufacturing subsidiaries, (GTE Lenkurt Electric and GTE Automatic Electric) it is not totally closed to outside suppliers, including Northern Electric. Thus, G.T.& E. can be considered a secondary market in the U.S.A.

In addition, the vast A.T.& T. controlled market is also not totally closed to suppliers outside of its own manufacturing arm, Western Electric. In the past, Northern Electric has penetrated this market to a limited extent with sales of switching equipment to the largest A.T.& T. operating subsidiary, Pacific Telephone & Telegraph. In addition, A.T.& T. has recently set up a centralized division which

will be responsible for evaluating equipment sold by suppliers other than Western Electric and for making centralized purchases on behalf of its operating telephone subsidiaries. The operating subsidiaries, however, will be allowed to maintain their autonomy by continuing to make their own independent purchases if they so desire.

This action by A.T.& T. is quite positive for independent suppliers such as Northern Electric since it indicates a further opening up of a market that, in the past, was almost entirely a preserve of Western Electric. On the other hand, the price that may be paid by all telecommunications equipment manufacturers over the longer term is the emergence of an aggressive Western Electric in the telecommunications equipment markets of the world. Until recently, Western Electric, with its captive A.T.& T. market, remained aloof from other markets; in fact, only recently did it establish a sales department. Thus, the emergence of Western Electric on the competitive scene is a development that will likely have serious effects. For Northern Electric, however, the opening up of the A.T.& T. market appears to offer sufficient potential to more than offset the competitive threat of an independent Western Electric.

In Europe, as indicated on page 29 of this report, accurate statistics on a consistent continent-wide basis are non-existent; national statistics are available in varying degrees of detail, but are on a non-comparable basis with other national data. However, as mentioned earlier in this report, an attempt at putting together the disparate information from the major seven countries of Western Europe (major in terms of either size of the telecommunications service, or degree of development in terms of international influence in telephony) was made by Euro Economics, which is the economic research arm of Eurofinance S.A., the major shareholders of which are leading banks in Western Europe, Canada, U.S.A. and Japan. Thus, the following table summarizes the estimates of the size and development of the Western European market.

Table 18

Investment in Telecommunications by European Operators(1)
1969-1974

		1969	1970	1971	1972	1973	1974	Growth 69/74 %/year
Local Currencies (Billions)								
U.K.(2)	£	0.33	0.45	0.43	0.54	0.62	0.69	15.9
W. Ger.	DM	4.0	4.7	5.4	6.4	6.9	5.7e	7.3
France	FF	2.7	3.4	5.1	6.8	8.4	9.9e	28.7
Italy(3)	Lir.	190	240	310	470	660	610e	26.3
Sweden	Kr	0.63	0.64	0.67	0.67	0.72e	0.78e	4.4
Neth.(4)	Fl	0.47	0.52	0.58	0.68	0.68	0.71e	8.6
Belg.	BF	6.3	6.2	7.9	8.0	8.1	9.4	8.3

(1) Refers only to the operators of the Public Telephone Networks (P.T.T.'s)
(2) Years ended March 31.
(3) Investment by S.I.P.
(4) Estimated from information published in Annual Report of the P.T.T.

Source: Euro Economics: Telecommunications Industry in Western Europe - 1975.

Although statistics are available on the size of and the trends in telecommunications equipment markets in other parts of the world, notably Japan, South America, Australia, Asia, etc., system incompatabilities and/or tariff and non-tariff barriers that lead to the closing off of local markets to international trade, makes it very difficult for Northern Electric and other international competitors to enter those markets. Hence, we have not presented information on those countries in this report.

Turning back to Northern Electric, the table below shows the trend of Northern Electric's sales divided according to major customers.

Table 19

Bell's & Subsidiaries' Construction Expenditures & Northern Electric's Sales by Customer, 1971-1977

($'000)

	Past				Projected		
Northern Electric Sales to Bell Canada Group	1971	1972	1973	1974	1975	1976	1977
1) Sales to Bell Canada:							
Bell Canada construction expenditures	$471,633	$507,716	$554,218	$783,103	$803,000	$950,000	$1,050,000
% increase	17.3%	7.7%	9.2%	41.3%	2.5%	18.3%	10.5%
Northern Electric sales to Bell Canada	$301,292	$297,983	$316,983	$461,883	$446,700	$522,500	$577,500
% increase	19.8%	(1.1%)	6.4%	45.7%	(3.3%)	17.0%	10.5%
as % of Bell	63.9%	58.7%	57.2%	59.0%	55.6%	55.0%	55.0%
2) Sales to Bell Subsidiaries:							
Bell subsidiaries construction expenditures	$82,928	$98,595	$139,243	$199,889	$225,000	$250,000	$280,000
% increase	4.5%	18.9%	41.2%	43.6%	12.6%	11.1%	12.0%
Northern Electric sales to Bell subsidiaries	$15,617	$22,231	$29,406	$60,814	$75,000	$90,000	$106,400
% increase	(25.0%)	42.4%	32.3%	106.8%	23.3%	20.0%	18.2%
as % of Bell subsidiaries	18.8%	22.5%	21.1%	30.4%	33.3%	36.0%	38.0%
3) Total Bell Canada Group:							
Total Bell group construction expenditures	$554,561	$606,311	$693,461	$982,992	$1,028,000	$1,200,000	$1,330,000
% increase	15.2%	9.3%	14.4%	41.8%	4.6%	16.7%	10.8%
Northern Electric sales to total Bell group	$316,909	$320,214	$346,389	$522,697	$521,700	$612,500	$683,900
% increase	16.4%	1.0%	8.2%	50.9%	(0.2%)	17.4%	11.7%
as % of total Bell group	57.1%	52.8%	50.0%	53.2%	50.7%	51.0%	51.4%
Northern Electric Sales to Others							
1) Sales to other Canadian customers	$ n.a.	$165,935	$189,846	$318,413	$370,000	$434,750	$510,830
% increase	-	-	14.4%	67.7%	16.2%	17.5%	17.5%
2) Sales to U.S.A.	n.a.	26,876	47,537	91,116	95,000	140,000	170,000
% increase	-	-	76.9%	91.7%	4.3%	47.4%	21.4%
3) Other foreign sales	34,000	22,000	30,000	40,000	45,000	52,875	62,125
% increase	-	(35.3%)	36.4%	33.3%	12.5%	17.5%	17.5%
4) Less B.N.R. outside sales	1,105	712	951	1,515	1,700	1,900	2,100
5) Net Northern Electric sales to others	$259,387	$214,099	$266,432	$448,014	$508,300	$625,725	$740,855
% increase	(11.0%)	(17.5%)	24.4%	68.2%	13.5%	23.1%	18.4%
Total Northern Electric sales	$576,296	$534,313	$612,821	$970,711	$1,030,000	$1,238,225	$1,424,755
% increase	2.3%	(7.3%)	14.7%	58.4%	6.1%	20.2%	15.1%

In 1974, Bell Canada spent $783.1 million on its capital expansion program which represented an increase of 41% over the 1973 level. In 1975, it had planned to spend $835 million - $840 million but, because it was not granted the full rate increase that it had requested in August of this year, it cut back its capital spending program to an estimated $803 million for the full year. This is an increase of only 2.5% over the 1974 level. For 1976, an 18% increase to about $950 million is expected with a further 10% increase to the $1,050 million level forecast for 1977. It must be noted that, at this point in time, because of the government's anti-inflation program, there is a greater uncertainty with respect to Bell's equipment spending than at any similar time in the past few years. Bell, however, is confident that its rate increase requests are within the guidelines and that it will be granted the bulk of the latest requested increase, and that, therefore, it will be able to continue with its planned spending. Furthermore, the government has stated that dividend increases will be allowed in cases where they are needed for a company to raise capital. Since Bell falls in this category, it will likely be able to raise the necesary capital; consequently, this constraint to capital spending will likely not present a problem.

Bell's subsidiaries spent approximately $200 million in 1974 and an increase to approximately $225 million is expected in the current year and to $250 million the following year. Northern Electric accounts for a much smaller percentage of that group of companies' capital spending, but it is rising steadily. In 1974, Northern Electric received approximately 30% of the subsidiaries' capital spending and we estimate that this will rise to 33% in 1975, to 36% in 1976 and to 38% in 1977. It is doubtful that it will reach the approximately 55% level of Bell because of the existence in operating territories of these subsidiaries of plants of competitors to Northern Electric.

In total, the Bell Canada group spent $983 million in 1974 and this is expected to rise to $1,028 million in 1975, to $1.2 billion in 1976 and to $1.33 billion in 1977. Northern Electric had 53% of that business in 1974 and because of the lower level of Bell's business in 1975, Northern Electric's share will likely slip to approximately 50% this year.

Northern Electric's share of the Bell group's capital expenditures in fact is slightly lower than is shown in the table since sales by Northern Electric to Bell and its subsidiaries comprises maintenance items as well as capital goods. Since the two cannot be separated, the result is that Northern Electric's share of Bell's capital spending program is slightly inflated.

Sales to other Canadian customers represents, in particular, Northern Electric's penetration of business in Western Canada which it had ignored in previous years. Primarily, this is business to the Alberta Government Telephone system, the Edmonton Telephone system, the Saskatchewan Telephone system and to the Manitoba Telephone system, all of which are owned and operated by their respective governments. Also, some sales have been made to B.C. Telephone, although B.C. Telephone, being an indirect subsidiary of General Telephone & Electronics of the U.S.A., buys the major portion of its equipment from the Canadian manufacturing subsidiaries of G.T.& E., namely GTE Lenkurt Electric (Canada) Limited and GTE Automatic Electric (Canada) Limited.

Sales to the U.S.A. have shown impressive strength, having risen by almost 92% in 1974. Another 4% gain to approximately $95 million is expected this year and a sharp gain of 40% - 50% is expected in 1976 to approximately $140 million as the

U.S. economy recovers and as the U.S. independent telephone companies increase their capital spending programs.

Other foreign sales represent primarily sales to Turkey and a small amount of sales to Europe. This is not expected to increase significantly over the next three years.

B.N.R. outside sales are sales by the 49% owned research laboratory, Bell Northern Research. These are revenues from research contracts for the government, the military and other outside bodies. This category of revenues is expected to remain small.

In its 1974 annual report, Northern Electric, for the first time, provided a detailed breakdown of sales by product categories and this was expanded in subsequent prospectuses. Therefore, the breakdown by product categories for the past four years and our estimates to 1977 are shown below.

Table 20

Northern Electric - Sales by Product Group, 1971-1977

($'000)

	Past				Projected		
Sales	1971	1972	1973	1974	1975	1976	1977
Switching	$178,753	$161,210	$177,122	$313,705	$338,000	$410,000	$501,200
% Increase	(4.8%)	(9.8%)	9.9%	77.1%	7.7%	21.3%	22.2%
Wire & Cable	$135,561	$119,388	$137,551	$190,815	$200,000	$225,000	$240,000
% Increase	(5.8%)	(11.9%)	15.2%	38.7%	4.8%	12.5%	6.7%
Subscriber apparatus & business Communications systems	$94,953	$106,707	$117,401	$181,378	$190,000	$240,000	$272,700
% Increase	5.8%	12.4%	10.0%	54.5%	4.8%	26.3%	13.6%
Transmission	$65,114	$56,049	$69,556	$103,208	$110,000	$148,620	$172,000
% Increase	44.0%	(13.9%)	24.1%	48.4%	6.6%	35.1%	15.7%
Others	$1,542	$8,117	$16,056	$23,676	$24,500	$27,105	$29,670
% Increase	576.3%	426.4%	97.8%	47.5%	3.5%	10.6%	9.5%
Distribution of non-company manufactured products	$100,373	$82,842	$95,135	$157,929	$167,500	$187,500	$209,185
% Increase	0.7%	(17.5%)	14.8%	66.0%	6.1%	11.9%	11.6%
Total	$576,296	$534,313	$612,821	$970,711	$1,030,000	$1,238,225	$1,424,755
% Increase	2.3%	(7.3%)	14.7%	58.4%	6.1%	20.2%	15.1%
As % of Total:							
Switching	31.0%	30.2%	28.9%	32.3%	32.8%	33.1%	35.2%
Wire & Cable	23.5%	22.3%	22.4%	19.7%	19.4%	18.2%	16.8%
Subscriber apparatus & business communications systems	16.5%	20.0%	19.2%	18.7%	18.4%	19.4%	19.1%
Transmission	11.3%	10.5%	11.4%	10.6%	10.7%	12.0%	12.1%
Others	0.3%	1.5%	2.6%	2.4%	2.4%	2.2%	2.1%
Distribution of non-company manufactured products	17.4%	15.5%	15.5%	16.3%	16.3%	15.1%	14.7%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

The market share gains shown on the previous page for the Company's switching business represent the continuing success of its SP-1 central office switch and of its Pulse P.A.B.X. equipment. The increase in the relative importance of the sales of transmission equipment represents the extension of the LD-4 pulse-code coaxial cable from Ottawa to Toronto beyond its present Montreal-Ottawa route.

For the first nine months of the current fiscal year, sales were $784 million up 11.6% from the $702 million reported for the first nine months of 1974. The Company's order backlog at June 30, 1975 was $456 million, including $250 million of switching equipment, which in turn included $187 million of backlog for the SP-1 electronic switching system; the remainder of the Company's backlog is spread over the other product categories, including the distribution division.

Direct Operating Costs and Gross Profit

A summary of the Company's cost of sales, selling, general and administrative expenses and research and development costs (which are fully expensed) is shown in the following table:

Table 21

Northern Electric - Sales, Cost of Sales, Other Expenses, and Operating Profit, 1972-1977

($'000)

	Past			Projected		
	1972	1973	1974	1975	1976	1977
Sales	$534,313	$612,821	$970,711	$1,030,000	$1,238,225	$1,424,755
Cost of sales(1)	394,892	438,526	703,731	721,350	879,072	1,018,448
Gross profit	$139,421	$174,295	$266,980	$308,650	$359,153	$406,307
Selling, general & administrative expenses(1)	54,485	65,906	94,012	109,740	130,786	148,806
Operating profit bef. R & D costs	$84,936	$108,389	$172,968	$198,910	$228,367	$257,501
R & D costs(1)	26,079	30,370	41,010	46,500	58,600	68,800
Profit before other income, interest costs, depreciation & income taxes	$58,857	$78,019	$131,958	$152,410	$169,767	$188,701
As % of Sales						
Cost of sales	73.91%	71.56%	72.50%	70.03%	71.00%	71.48%
Gross profit	26.09%	28.44%	27.50%	29.97%	29.00%	28.52%
Selling, general & administrative expenses(1)	10.20%	10.75%	9.68%	10.66%	10.56%	10.45%
Operating profit bef. R & D costs	15.90%	17.69%	17.82%	19.31%	18.44%	18.07%
R & D costs(1)	4.88%	4.96%	4.22%	4.51%	4.73%	4.83%
Profit before other income, interest costs, depreciation & income taxes	11.02%	12.73%	13.59%	14.80%	13.71%	13.24%

(1) After deducting an allocated amount of depreciation expense - see page 67.

The Company does not provide a separate figure for depreciation in its profit and loss statement but shows it in its source and application of funds statement. The depreciation expense is divided among the cost of sales account, the selling, general and administrative costs account and to research and development. Research and development last year totalled $44.1 million of which $41.0 million was labour; most of the remainder, i.e. $3.1 million or 7% of the total research and development expense, was depreciation. Deducting this from the total leaves $22.7 million of depreciation which was then divided 95% to cost of sales and 5% to selling, general and administrative expenses. For prior years, we have assumed that the same ratios were applicable, namely that about 7% of research and development expense is applicable to depreciation and that 95% of the remaining amount can be allocated to cost of sales and 5% to selling, general and administrative expenses. The actual split of depreciation is shown on page 67. Thus, the expense and profit figures shown on the previous page have been adjusted accordingly.

Labour

Another cost category which is divided between cost of sales, selling, general and administrative expenses, and research and development, is labour, which, in 1974, totalled $342.4 million.

Thus, before projections can be made of cost of sales and of selling, general and administrative expenses, it is necessary to project labour costs, and this is shown below:

Table 22

Northern Electric - Labour Costs, 1966-1977

	Past									Projected		
	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Total labour cost(1)(2) ($'Mill.)	$144.0	$157.1	$175.4	$205.1	$231.6	$228.3	$222.2	$249.2	$342.4	$411.3	$475.3	$530.8
Employees at year end(2)	23,864	22,557	23,862	26,032	24,986	23,230	20,787	25,073	26,147	26,000	26,400	26,800
Average no. of employees(2)	21,748	23,211	23,120	24,857	25,509	24,108	22,009	22,930	25,610	26,074	26,200	26,600
Cost per employee(2)	$6,621	$6,768	$7,587	$8,251	$9,079	$9,470	$10,096	$10,868	$13,370	$15,775	$18,140	$19,955
% Increase	4.8%	2.2%	12.1%	8.8%	10.0%	4.3%	6.6%	7.6%	23.0%	18.0%	15.0%	10.0%
Sales ($'000)	$400,217	$403,294	$426,272	$482,523	$563,611	$576,296	$534,313	$612,821	$970,711	$1,030,000	$1,238,225	$1,424,755
Sales per employee	$18,402	$17,375	$18,437	$19,412	$22,095	$23,905	$24,277	$26,726	$37,904	$39,503	$47,260	$53,562
Net Profit ($'000)	$9,603	$2,711	$9,003	$10,976	$5,025	$12,611	$20,295	$32,030	$53,753	$66,835	$79,940	$91,735
Net Profit per employee(3)	$442	$117	$389	$442	$197	$523	$922	$1,397	$2,099	$2,563	$3,051	$3,449

(1) Wages, benefits and pensions.
(2) Includes Bell Northern Research.
(3) As reported.

The table on the previous page shows a small reduction in the total number of employees this year, which is what is expected, followed by a small increase in the subsequent two years. Thus, with total employment growing only slowly, productivity measured in terms of sales per employee is continuing to increase impressively.

The increase in labour costs per employee has been kept to a 15% gain in 1976 and a 10% gain in 1977 based on the assumption that the government's wage and price guidelines will reduce somewhat the pressure for higher wages; to be conservative, we have not assumed the relatively low rate of increase suggested by the government's guidelines.

Labour costs are divided among cost of sales, selling, general and administrative expenses and research and development. Furthermore, part of the labour account is taken into inventory with finished goods; this is particularly important whenever inventories show a sharp increase, which was the case last year. In 1974, inventories increased $77.7 million of which approximately $30 million or about 40% represented labour. In addition, $41 million of labour was included in research and development. The remainder was divided $225 million to cost of sales and $46 million to selling, general and administrative expenses.

In order to obtain the past trend of labour costs that have entered into inventory, we have applied the same percentage to the past changes in inventory levels and we have obtained the following:

Table 23

Northern Electric - Components of Inventory Changes, 1966-1977

($'000)

	Past									Projected		
	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Increase(Decrease) in inventory	$32,143	($9,614)	$6,443	$30,379	($2,935)	($22,267)	$384	$64,750	$77,677	$25,000	$15,000	$15,000
Labour in inventory	$12,414	($3,713)	$2,488	$11,733	($1,134)	($8,600)	$148	$25,000	$30,000	$9,655	$5,800	$5,800
Materials and overhead in inventory	$19,729	($5,901)	$3,955	$18,646	($1,801)	($13,667)	$236	$39,750	$47,677	$15,345	$9,200	$9,200

In view of the slowdown occurring in the final half of the current fiscal year, we would expect an inventory rise of about 10% over last year's level since it is more economical for Northern Electric to maintain existing production levels rather than cut back temporarily. This reflects the fact that sales of telecommunications equipment tend to be deferred rather than permanently cancelled.

In 1974, $41 million of the $44.1 million spent on research and development represented labour. Applying the same ratio to prior years as well as to our forecast of research and development expenditures provides the following allocation of labour to research and development:

Table 24

Northern Electric - Labour Component of Research and Development Expenses, 1966-1977

($'000)

	Past									Projected		
	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
R & D expenses	$22,600	$23,800	$21,700	$25,900	$31,000	$29,700	$28,000	$32,656	$44,110	$50,000	$63,000	$74,000
Labour to R & D	$21,020	$22,135	$20,180	$24,090	$28,830	$27,620	$26,040	$30,370	$41,000	$46,500	$58,575	$68,800

The remaining labour costs, which relate directly to the Company's basic manufacturing and distribution business, are allocated in the same ratio as in 1974, i.e., 83% to cost of sales and 17% to selling, general and administrative expenses as follows:

Table 25

Northern Electric - Allocation of Labour Costs to Operating Expenses, 1966-1977

($'000)

	Past									Projected		
	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Total labour costs	$144,000	$157,100	$175,400	$205,100	$231,600	$228,300	$222,200	$249,200	$342,400	$411,300	$475,300	$530,800
Less amount to inventory and R & D	33,434	18,422	22,668	35,823	27,696	19,020	26,188	55,370	71,000	56,155	64,375	74,600
Labour to Northern Electric's basic business	$110,566	$138,678	$152,732	$169,277	$203,904	$209,280	$196,012	$193,830	$271,400	$355,145	$410,925	$456,200
Allocated to:												
Cost of sales	$91,770	$115,100	$126,768	$140,500	$169,240	$173,702	$162,690	$160,880	$225,200	$294,770	$341,070	$378,645
Selling, general & administrative expenses	$18,796	$23,578	$25,964	$28,777	$34,664	$35,578	$33,322	$32,950	$46,200	$60,375	$69,855	$77,555

Thus, the analysis above allocates labour among the three major categories of cost of sales, selling, general and administrative expenses, research and development plus the amount that is included in the buildup of inventories. This is summarized in table 26 on the following page.

Table 26

Northern Electric - Summary of Labour Cost Allocations, 1966-1977

($'000)

Summary of Allocation of Labour Costs:	Past									Projected		
	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Cost of sales	$91,770	$115,100	$126,768	$140,500	$169,240	$173,702	$162,690	$160,880	$225,200	$294,770	$341,070	$378,645
Selling, General and administrative expenses	18,796	23,578	25,964	28,777	34,664	35,578	33,322	32,950	46,200	60,375	69,855	77,555
R & D expenses	21,020	22,135	20,180	24,090	28,830	27,620	26,040	30,370	41,000	46,500	58,575	68,800
Inventory	12,414	(3,713)	2,488	11,733	(1,134)	(8,600)	148	25,000	30,000	9,655	5,800	5,800
Total Labour	$144,000	$157,100	$175,400	$205,100	$231,600	$228,300	$222,200	$249,200	$342,400	$411,300	$475,300	$530,800

Research and Development

The research and development expenses shown have been kept to about 5% of sales, according to the Company's policy. Research and development expenses are shown separately in the following table.

Table 27

Northern Electric - Research and Development Expenses, 1966-1977

($'Millions)

	Past									Projected		
	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
R & D expenses:												
Labour	$21.0	$22.1	$20.2	$24.1	$28.8	$27.6	$26.1	$30.4	$41.0	$46.5	$58.6	$68.8
Depreciation and others	1.6	1.7	1.5	1.8	2.2	2.1	2.0	2.3	3.1	3.5	4.4	5.2
Total R & D	$22.6	$23.8	$21.7	$25.9	$31.0	$29.7	$28.0	$32.7	$44.1	$50.0	$63.0	$74.0
% Increase	37.8%	5.3%	(8.8%)	19.4%	19.7%	(4.2%)	(5.7%)	16.8%	34.9%	13.4%	26.0%	17.5%
R & D as % of sales	5.65%	5.90%	5.10%	5.37%	5.50%	5.15%	5.25%	5.33%	4.54%	4.85%	5.09%	5.19%

As indicated earlier, Northern Electric writes off all of its research and development expenses as incurred.

Cost of Sales

Given the labour cost picture as shown above, the recent history of the Company's cost of sales and our projections to 1977 are shown below:

Table 28

Northern Electric - Cost of Sales, 1967-1977

($'000)

	Past								Projected		
	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Sales	$403,294	$426,272	$482,523	$563,611	$576,296	$534,313	$612,821	$970,111	$1,030,000	$1,238,225	$1,424,755
Cost of Sales:											
Labour attributable to Cost of Sales	115,100	126,768	140,500	169,240	173,702	162,690	160,880	225,200	294,770	341,070	378,645
Materials and other services attributable to Cost of Sales	252,245	253,545	283,806	342,601	334,790	232,202	277,646	478,531	426,580	538,002	639,803
Cost of Sales excl. depreciation	$367,345	$380,313	$424,306	$511,841	$508,492	$394,892	$438,526	$703,731	$721,350	$879,072	$1,018,448
Depreciation attributable to Cost of Sales	6,618	8,016	8,288	9,677	9,148	10,533	13,585	21,558	16,625	17,757	18,446
Total Cost of Sales as reported	$373,963	$388,329	$432,594	$521,518	$517,640	$405,425	$452,111	$725,289	$ 737,975	$ 896,829	$1,036,894
As % of sales:											
Labour attributable to Cost of Sales	28.54%	24.74%	29.12%	30.03%	30.13%	30.45%	26.25%	23.20%	28.62%	27.55%	26.58%
Materials attributable to Cost of Sales	62.55%	59.48%	58.82%	60.79%	58.10%	43.46%	45.31%	49.30%	41.42%	43.45%	44.90%
Cost of Sales excl. depreciation	91.09%	89.22%	87.93%	90.81%	88.23%	73.91%	71.56%	72.50%	70.04%	71.00%	71.48%
Depreciation attributable to Cost of Sales	1.64%	1.88%	1.72%	1.72%	1.59%	1.97%	2.22%	2.22%	1.61%	1.43%	1.30%
Total Cost of Sales as reported	92.73%	91.10%	89.65%	92.53%	89.82%	75.88%	73.78%	74.72%	71.65%	72.43%	72.78%
As % of Cost of Sales:											
Labour	31.33%	33.33%	33.11%	33.06%	34.15%	41.20%	36.69%	32.00%	40.86%	38.80%	37.18%
Materials	68.67%	66.67%	66.89%	66.94%	65.85%	58.80%	63.31%	68.00%	59.14%	61.20%	62.82%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

In this report, for ease of analysis, we have deducted from cost of sales the applicable depreciation calculated as shown in table 30 on page 67 to arrive at the direct operating cost figure. In the table above, in order to be consistent with the figures shown in the annual report, we have added back the applicable depreciation to show cost of sales as reported.

The rise in the relative importance of labour in 1972 reflected the fact that sales declined owing primarily to the phasing out of unprofitable product lines without a corresponding cut in the labour work force. With the resumption of sales growth in the following two years, the importance of labour in cost of sales dropped back.

The decline in the relative importance of materials costs estimated for 1975 reflects primarily the drop in the price of copper from the very high levels experienced in 1974. Correspondingly, labour increased in importance. Over the subsequent two years, the ratio of labour costs to material costs is expected to swing back slowly to lower labour and higher materials, particularly if the government's wage and price guidelines succeed in controlling labour wage rates throughout the country. Materials, on the other hand, are subject to international prices based on world wide supply and demand and, therefore, will not be affected by the government's anti-inflation actions.

The situation with respect to labour is discussed at greater length on page 51. In essence, Northern Electric's contracts will be up for renewal in early 1976 and the possibility of one or more strikes exists. To a greater extent, the Company's major customers, particularly Bell Canada, do not and for much of the situation, cannot, quickly divert their purchases to other suppliers; hence, in the event of a strike, sales are deferred rather than lost.

Selling, General and Administrative Expenses

Turning to the other category of direct operating costs, selling, general and administrative expenses, the following table shows the recent record and our projections to 1977.

Table 29

Northern Electric - Selling, General & Administrative Expenses
1972-1977

($'000)

	Past			Projected		
	1972	1973	1974	1975	1976	1977
Sales	$534,313	$612,821	$970,711	$1,030,000	$1,238,225	$1,424,755
Selling, general & administrative expenses						
Labour attributable to selling, general & administrative expenses	33,322	32,950	46,200	60,375	69,855	77,555
Others	21,163	32,956	47,812	49,365	60,931	71,251
Total selling, general & administrative expenses	$ 54,485	$ 65,906	$ 94,012	$ 109,740	$ 130,786	$ 148,806
Depreciation attributable to selling, general & administrative expenses	554	716	1,139	875	935	970
Selling, general & administrative expenses as reported	$ 55,039	$ 66,622	$ 95,151	$ 110,615	$ 131,721	$ 149,776
As % of Sales:						
Labour attributable to selling, general & administrative expenses	6.24%	5.38%	4.76%	5.86%	5.64%	5.44%
Others	3.96%	5.38%	4.93%	4.79%	4.92%	5.00%
Total selling, general & administrative expenses	10.20%	10.75%	9.69%	10.65%	10.56%	10.44%
Depreciation attributable to selling, general & administrative expenses	0.10%	0.12%	0.12%	0.09%	0.08%	0.07%
Selling, general & administrative expenses as reported	10.30%	10.87%	9.80%	10.74%	10.64%	10.51%

The "others" category shown above includes rent which is the biggest item, outside services such as computer services and data banks, advertising and promotion, travelling, etc.

Depreciation

In 1974, Northern Electric charged $25.8 million as depreciation expense in its income statement. The history of depreciation and our projections are shown in the table on the following page.

Table 30

Northern Electric - Gross Fixed Assets, Capital Expenditures, Depreciation Rate, 1967-1977

($'000)

	Past								Projected		
	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Gross fixed assets beginning of year	$167,189	$185,298	$194,462	$214,869	$233,221	$230,019	$237,528	$261,547	$278,217	$298,217	$318,217
Add capital expenditures	20,071	12,833	23,949	20,833	21,883	11,617	26,802	33,728	25,000	25,000	25,000
Less adjustments	1,962	2,408	3,542	2,481	25,085	4,108	2,783	17,058	5,000	5,000	5,000
Gross fixed assets end of year	185,298	195,723 (1)	214,869	233,221	230,019	237,528	261,547	278,217	298,217	318,217	338,217
Average gross fixed assets	176,244	190,511	205,296	224,045	231,620	233,774	249,538	269,882	288,217	308,217	328,217
Depreciation	8,631	9,958	10,534	12,356	11,709	13,047	16,587	25,797	21,000	23,117	24,616
Average depreciation rate	4.90%	5.23%	5.13%	5.51%	5.06%	5.58%	6.65%	9.56%	7.29%	7.50%	7.50%
Allocation of Depreciation:											
Cost of sales	$6,618	$8,016	$8,288	$9,677	$9,148	$10,533	$13,585	$21,558	$16,625	$17,757	$18,446
Selling, general & administrative expenses	348	422	436	509	481	554	716	1,139	875	935	970
Research & Development	1,665	1,520	1,810	2,170	2,080	1,960	2,286	3,100	3,500	4,425	5,200
Total Depreciation	$8,631	$9,958	$10,534	$12,356	$11,709	$13,047	$16,587	$25,797	$21,000	$23,117	$24,616

(1) Restated to $194,462 in 1969 annual report.

In 1975, depreciation is expected to decline to about $21 million owing to the closing down of Microsystems International Limited, and an increase to slightly over $23 million is expected for 1976. The allocation of the depreciation expense shown above is based on 7% of research and development expenditures being depreciation, and the remaining depreciation being divided 95% to cost of sales and 5% to selling, general and administrative expenses.

Interest Costs and Capital Spending

At the end of 1974, Northern Electric's long term debt totalled $104.5 million and dropped to $102.9 million at June 30, 1975 and to $62.4 million one month later, i.e. July 31, 1975.

Short term bank loans totalled $130,000 at December 31, 1974 but by June 30, 1975 these had increased to $31.6 million. They were repaid on July 31, 1975.

The amount of long term debt payable is $8.1 million in 1976, $40.2 million in 1977, $4.1 million in 1978, $3.8 million in 1979 and $3.7 million in 1980.

Northern Electric's capital spending program has slowed down considerably in the current year. The record of spending on plant expansion and improvement by Northern Electric is as follows:

Table 31

Northern Electric - Capital Expenditures, 1965-1977

($'Millions)

	Past										Projected		
	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Capital spending	$15.3	$23.0	$19.7	$12.4	$24.2	$20.9	$21.9	$19.5	$26.8	$33.7	$25.0	$25.0	$25.0

The spending over the past five years has concentrated on the modernization of existing facilities and the replacement of older plants by new, highly efficient ones. In fact, during this period, Northern Electric evolved from a company operating a small number of large and very old, dirty manufacturing facilities to one with a larger number of new smaller plants, operated in a clean "white lab-coat" environment. Of course, the raw, traditional manufacturing has not been completely eliminated; for example, the Company's copper foundry and cable plant are still basic, hot and dirty operations, although substantially improved over their former state.

The capital spending program envisages about $25 million per year being spent with no more major new plants being planned. This, of course, excludes any major diversification move or acquisitions; such a move is not under consideration at present.

Therefore, without allowing for any acquisitions that would require additional outside funds, we expect that the Company's long term interest cost will decline steadily over the next few years.

Earnings

Combining the forecast of sales, direct and indirect operating costs, we arrive at the forecast of profits shown in the table on the following page.

Table 32

Northern Electric - Earnings, 1972-1977

($'000)

	Past			Projected		
	1972	1973	1974	1975	1976	1977
Profit before other income, interest costs, depreciation & income taxes	$58,857	$78,019	$131,958	$152,410	$169,767	$188,701
Depreciation	13,047	16,587	25,797	21,000	23,117	24,616
Other income	2,080	3,816	2,945	2,000	2,000	2,000
Long term interest costs	5,328	5,045	4,605	8,200	4,900	1,270
Short term interest costs	308	1,545	3,114	1,000	1,000	1,000
Pre-tax profit	$42,254	$58,658	$101,387	$124,210	$142,750	$163,815
Income tax	23,608	30,611	50,663	54,652	62,810	72,080
Net profit before minority interest	$18,646	$28,047	$50,724	$69,558	$79,940	$91,735
Minority interest in net loss of subsidiaries	1,649	3,983	3,029	(2,723)	-	-
Net profit	$20,295	$32,030	$53,753	$66,835	$79,940	$91,735
Number of shares outstanding	23,569	26,163	26,210	26,500	26,500	26,500
Net per share	$0.86	$1.35	$2.05	$2.55	$3.00	$3.45

Breakdowns of Northern Electric's sales and profits from the U.S.A. and from NEDCO (its distribution subsidiary) and, by subtraction, from its Canadian and overseas activities for the past three years, and our projections to 1977, are shown in the table on the following page.

Table 33

Northern Electric - Breakdown of Profits, 1972-1977

($'000)

	Sales				Pre-Tax Profit				Net Profit			
	Total Tel.Co's Europe & Canada	Distribution Organization	U.S.A.	Total	Total Tel.Co's Europe & Canada	Distribution Organization	U.S.A.	Total	Total Tel.Co's Europe & Canada	Distribution Organization	U.S.A.	Total
1972	$454,690	$52,747	$26,876	$534,313	$37,287	$1,687	$3,280	$42,254	$17,812	$876	$1,607	$20,295
Margin					8.20%	3.20%	12.20%	7.91%	3.92%	1.66%	5.98%	3.80%
1973	$442,980	$122,304	$47,537	$612,821	$47,463	$5,451	$5,744	$58,658	$26,533	$2,659	$2,838	$32,030
Margin					10.71%	4.46%	12.08%	9.57%	5.99%	2.17%	5.97%	5.23%
1974	$685,151	$194,444	$91,116	$970,711	$82,395	$11,063	$7,929	$101,387	$44,591	$5,263	$3,899	$53,753
Margin					12.03%	5.69%	8.70%	10.44%	6.51%	2.71%	4.28%	5.54%
1975	$727,500	$207,500	$95,000	$1,030,000	$100,760	$13,000	$10,450	$124,210	$51,620	$10,500	$4,715	$66,835
Margin					13.85%	6.27%	11.00%	12.06%	7.09%	5.06%	4.96%	6.48%
1976	$875,725	$222,500	$140,000	$1,238,225	$113,400	$13,700	$15,650	$142,750	$57,615	$13,700	$8,625	$79,940
Margin					12.95%	6.16%	11.18%	11.53%	6.58%	6.16%	6.16%	6.46%
1977	$995,570	$259,185	$170,000	$1,424,755	$129,015	$16,025	$18,775	$163,815	$62,253	$16,025	$13,457	$91,735
Margin					12.96%	6.18%	11.04%	11.50%	6.25%	6.18%	7.92%	6.44%

The table above indicates the steady increase in profit margins on sales to telephone companies in Canada and Europe and the further increase which is expected in the current fiscal year. Likewise, it indicates the sharp improvement in profit margins from the other two divisions in the current fiscal year.

In view of the effects of the government's wage and price controls on the Company's Canadian operations, we would expect to see pressure on margins of the Company's Canadian subsidiaries while we would expect to see a continuation of the improvement in margins in the U.S.A. This is in fact what is shown above.

The closing down of Microsystems has resulted in an accumulated tax loss of approximately $45 million which Northern Electric will utilize in its NEDCO operation. Therefore, the table above shows no tax payable by the distribution organization in 1976 and 1977.

Factors Contributing to Earnings Growth

The factors contributing to earnings growth for the past two years and to 1977, are shown in the table below:

Table 34

Northern Electric - Factors Contributing to Earnings Growth, 1973-1977

	1973/72		1974/73		1975/74		1976/75		1977/76	
	$'000	% Change	$'000	% Change	$'000	% Change	$'000	% Change	$'000	% Change
Sales	$78,508	14.69%	$357,890	58.40%	$59,289	6.11%	$208,225	20.22%	$186,530	15.06%
Cost of sales (1)	43,634	11.05%	265,205	60.48%	17,619	2.50%	157,722	21.86%	139,376	15.85%
Gross profit (1)	34,874	25.01%	92,685	53.18%	41,670	15.61%	50,503	16.36%	47,154	13.13%
Selling, general and administrative expenses (1)	11,421	20.90%	28,106	42.65%	15,728	16.73%	21,046	19.18%	18,020	13.78%
Operating profit bef. R & D costs	23,453	27.61%	64,579	59.58%	25,942	15.00%	29,457	14.81%	29,134	12.76%
R & D expenses (1)	4,291	16.45%	10,640	35.03%	5,490	13.39%	12,100	26.02%	10,200	17.41%
Operating profit (1)	19,162	32.56%	53,939	69.14%	20,452	15.50%	17,357	11.39%	18,934	11.15%
Depreciation	3,540	27.13%	9,210	55.53%	(4,797)	(18.60%)	2,117	10.08%	1,499	6.48%
Income from short term investments	1,736	83.46%	(871)	(22.82%)	(945)	(32.09%)	-	-	-	-
Long term interest costs	(283)	(5.31%)	(440)	(8.72%)	3,595	78.07%	(3,300)	(40.24%)	(3,630)	(74.08%)
Short term interest costs	1,237	401.62%	1,569	101.55%	(2,114)	(67.89%)	-	-	-	-
Pre-tax profit	16,404	38.82%	42,729	72.84%	22,823	22.51%	18,540	14.93%	21,065	14.76%
Income taxes	7,003	29.66%	20,052	65.51%	3,989	7.87%	8,158	14.93%	9,270	14.76%
Profit before minority interest	9,401	50.42%	22,677	80.85%	18,834	37.13%	10,382	14.93%	11,795	14.75%
Minority interest	2,334	141.54%	(954)	(23.95%)	(5,752)	(189.90%)	2,723	100.00%	-	-
Net profit	11,735	57.82%	21,723	67.82%	13,082	24.34%	13,105	19.61%	11,795	14.75%
Net per share	$0.50	58.82%	$0.70	51.85%	$0.50	24.39%	$0.45	17.65%	$0.45	15.00%

(1) Excluding depreciation.

The table above shows the changes in the various components of the profit and loss statement. It can be seen that in 1974, cost of sales grew more rapidly than sales. On the other hand, selling, general and administrative costs and research and development expenses grew less rapidly than sales and gross profit. Income from short term investments dropped off but on the other hand, the absolute amount of the decline was relatively small. Short term interest costs increased considerably, but again, in absolute dollar terms, the amount was relatively small. Consequently, the pre-tax profit increased by 72.8%, compared to a sales gain of 58.3% and a gross profit improvement of 53.0%. The minority interest brought the net profit gain down to 67.8% and the increase in the number of shares outstanding brought the net per share increase to 51.9%. In 1975, a higher gross profit improvement is expected relative to sales while selling, general and administrative costs will increase somewhat more rapidly. The end result is a 24% increase in net profit and net profit per share.

Asset Turnover and Return Ratios

The trend in a number of key ratios for Northern Electric is shown below:

Table 35

Northern Electric - Asset Turnover and Return Ratios, 1963-1977

	Real Average Asset Turnover	x	Pre-tax Margin	=	Pre-tax Return on Assets	x	Total Leverage	=	Pre-tax Return on Equity	x	Tax Retention Rate	=	Net Return on Equity
1963	1.86		5.48%		10.17%		1.97		20.06%		51.55%		10.34%
1964	1.85		5.88		10.88		1.95		21.23		54.26		11.52
1965(1)	1.92		3.03		5.82		1.94		11.29		73.36		8.28
1966	1.84		2.63		4.85		1.94		9.38		91.12		8.55
1967(2)	1.69		0.67		1.13		1.80		2.03		100.00		2.05
1968(3)	1.70		3.31		5.60		1.77		9.95		63.88		6.35
1969	1.64		4.25		6.95		1.81		12.61		53.51		6.75
1970	1.64		1.34		2.19		1.90		4.16		66.52		2.77
1971	1.58		4.26		6.75		1.98		13.40		51.33		6.88
1972(4)	1.47		7.91		11.31		1.99		22.48		48.03		10.80
1973	1.42		9.57		13.58		1.98		26.84		54.60		14.65
1974	1.83		10.44		19.14		2.00		38.24		53.02		20.27
1975(E)	1.85		12.06		22.31		1.79		39.84		53.81		21.44
1976(E)	1.85		11.53		21.33		1.80		38.44		56.00		21.52
1977(E)	1.85		11.50		21.27		1.74		36.94		56.00		20.68

(1) Change in consolidation.
(2) Shift in some deferred credits to retained earnings in following year's annual report.
(3) Change in method of accounting for capital grants resulted in a restatement of retained earnings and in the plant and machinery accounts in following year's annual report.
(4) Change in the accumulated deferred income tax account resulted in a restatement of the 1972 annual report in following year and an increase in total assets.

Of particular interest in the table above is the deterioration in real asset turnover which began in 1967 and which lasted until 1973. In 1974, the Company regained its former high level of asset turnover and we believe that this ratio will remain at approximately the 1.85 level over the next three years. The average real asset turnover is a ratio that measures the amount of real assets (excluding intangibles such as deferred charges and goodwill) required to sustain a certain level of sales. The higher the ratio, the more efficiently assets are used in generating sales. Although the improvement in 1974 was a reflection of the very sharp increase in sales in that year, the further increases in sales that are expected will not likely require significant additional assets; hence we believe that the ratio at least will remain at approximately the level reached in 1974, although there could be a further improvement. The drops in all the ratios in 1970 were due to a series of strikes, averaging about eight weeks, and the beginning of losses from Microsystems.

The table on the previous page shows that the Company's pre-tax margin has been improving steadily since the low of 0.67% in 1967, except for a temporary drop in 1970. The pre-tax margin in 1974 was 10.44% and in 1975 it is expected to average approximately 12.06%. Our calculations indicate a small decline in 1976 and 1977, and this appears to be consistent with the government's current wage and price controls.

The pre-tax return on assets and the pre-tax return on equity have both been going up since the lows achieved in 1967 except for temporary declines in 1970. The increase in the pre-tax return on assets indicates that the Company has been able to increase the efficiency with which it has utilized its assets to generate profits. Likewise, its equity investment has been put to better use as measured by the steady increase in the pre-tax return on equity. We show both these ratios as dropping off in 1975 with small declines in 1976 and 1977. Once again, this is consistent with the expected results given the regulatory environment.

The final calculation, i.e. the net return on equity, was 20.3% in 1974 and is expected to remain in approximately the 20% - 21.5% range over the next three years.

Dividends

Northern Electric's earnings per share and dividend record has been as follows:

Table 36

Northern Electric - Dividends, 1965-1975

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975 (Est.)
Earnings/ share	$0.65	$0.70	$0.12	$0.49	$0.52	$0.17	$0.54	$0.85	$1.35	$2.05	$2.55
Dividend/ share	$0.50	$0.50	$0.50	$0.50	$0.50	$0.38	$0.50	$0.50	$0.50	$0.52½	$0.60

The dividend rate is reviewed in the first quarter of the year and, given the increase in earnings that we have calculated for the next two years, further increases in the dividend could be expected. However, the Company's major shareholder, Bell Canada, is regulated on the basis of a maximum rate of return on capital, and that return is much lower than the return earned currently by Northern Electric, hence a high payout ratio on the part of Northern Electric is not likely. Furthermore, the Canadian federal government's wage and price guidelines have frozen dividends at their current annualized rates. Therefore, an increase beyond the current 60¢ per share is not expected before 1977.

Capitalization

The consolidated capitalization of Northern Electric at July 31, 1975 was as follows:

Table 37

Northern Electric - Capitalization

Long term debt	$'000	% of Total
Northern Electric	$59,255	
Subsidiary Companies	3,151	
	$62,406	16.3%
Equity (26,469,287 shares)	319,810	
Total	$382,216	83.7%
		100.0%

Net tangible book value per share at July 31, 1975 was $11.73 and return on equity in 1974 was 20.3%.

The Company has authorized capital of 39 million common shares for an aggregate value of $225 million. The number of shares outstanding at July 31, 1975 was 26,469,287 shares.

Prior to December 1973, Northern Electric was a wholly owned subsidiary of Bell Canada. At that time, Northern Electric sold to the public 2.6 million treasury shares at $15 per share. In October 1974, Bell sold 2 million warrants exercisable prior to December 1, 1979, allowing holders to purchase 2 million common shares of Northern Electric owned by Bell Canada at $21.50 per share. In October 1975, Bell sold 5,250,000 shares of Northern Electric together with 5,250,000 half warrants to purchase 2,625,000 shares of Bell Canada. Therefore, currently, Bell Canada directly owns 18,311,845 shares of Northern Electric and, after the full conversion of the warrants outstanding, it will own 16,311,845 shares, or 61.6% of the total number of Northern Electric shares outstanding.

The number of shares outstanding shown above takes into consideration the issue on December 9, 1974 of 47,056 shares at an average price of $16.55 to shareholders of Microsystems International Limited on the basis of one Northern Electric share for seven shares and 15 share purchase warrants of Microsystems.

Balance Sheet

Northern Electric's balance sheet at December 31, 1973 and 1974 is summarized below:

Table 38

Northern Electric - Balance Sheet

($'000)

	1973	1974
ASSETS		
Current Assets		
Cash and short term investments	$ 75,613	$ 14,081
Receivables	101,089	144,900
Inventories	177,295	254,972
Prepaid expenses	1,929	5,447
Deferred income taxes	11,339	14,343
Total Current Assets	$367,265	$433,743
Investment in affiliated company at cost	6,487	8,960
Other investments	2,250	1,697
Plant & equipment (net)	119,043	119,986
Deferred charges and goodwill	4,420	3,409
Total Assets	$499,465	$567,795
LIABILITIES		
Current Liabilities		
Bank loans	$ 28,945	$ 130
Payables	105,989	116,815
Taxes payable	17,425	30,462
Current portion of long term debt	4,544	3,207
Total Current Liabilities	$156,903	$150,614
Long term debt	69,581	104,547
Deferred income taxes	20,958	23,690
Minority interest	6,974	3,742
Shareholders' equity	245,049	285,202
Total Liabilities	$499,465	$567,795

Working capital at December 31, 1974 totalled $283.1 million and the working capital ratio was 2.88:1 up from 2.34:1 at the end of 1973. Northern Electric's business requires a high level of working capital; for example, in 1974, sales increased $357.3 million and working capital increased $72.7 million.

Market Action

Northern Electric's stock was issued at $15 in December, 1973 and rose steadily to the $25 1/2 level in July 1974, before correcting back to the $14 1/2 level in December 1974. Subsequently, a long and steady uptrend took it to the $31 level in July 1975. The announcement of the issue of additional stock owned by Bell combined with the announcement of the federal government's anti-inflation moves, brought it down to a low price of $23 1/4. It subsequently recovered to $26 and is currently selling at $23 1/2 or 7.8 times estimated 1976 earnings. The yield on the 60¢ dividend is 2.6%. The stock is listed on the Toronto, Montreal and New York stock exchanges.

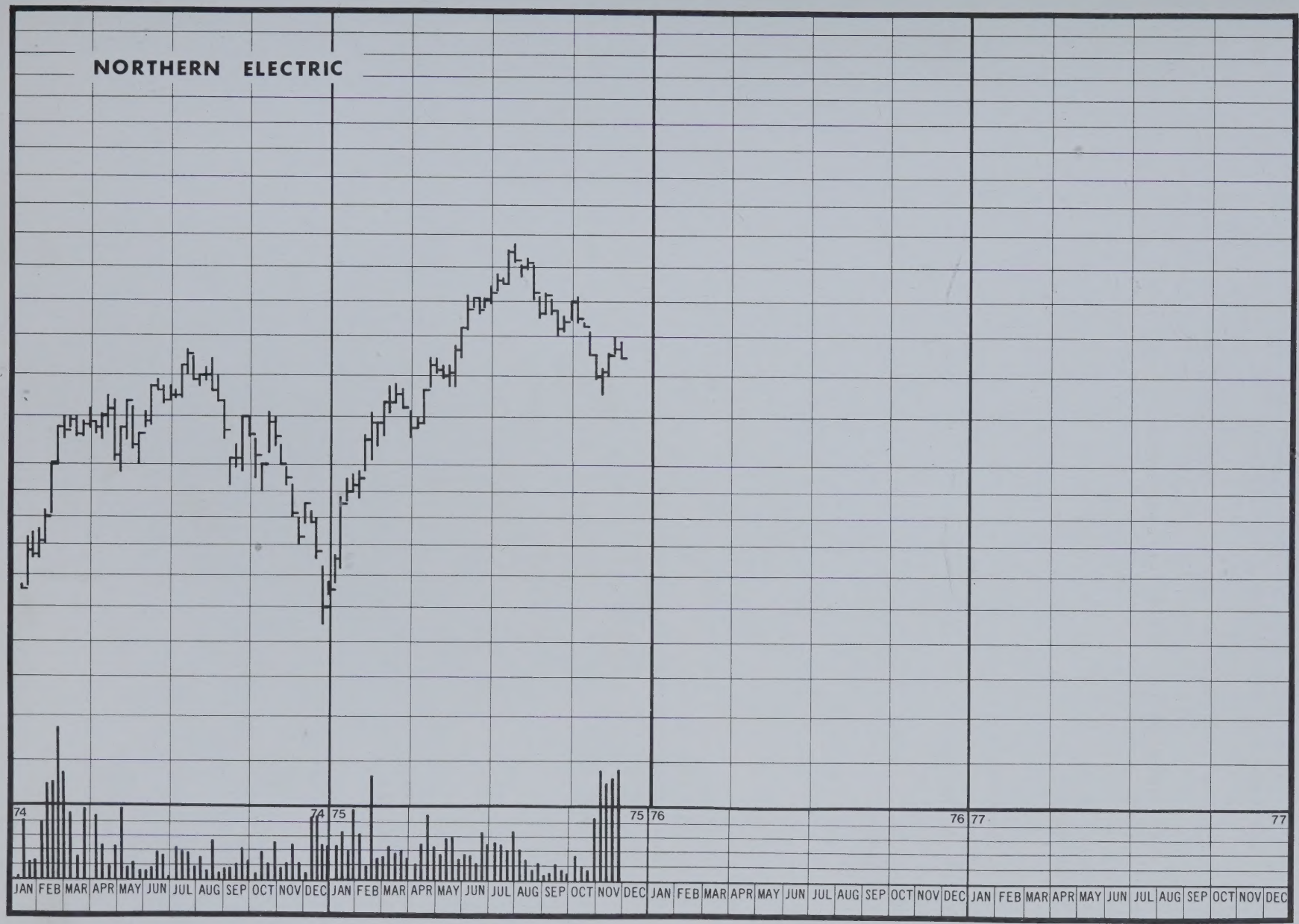
When the stock was initially issued, the large institutional interest could not be satisfied because of the thin float. The subsequent issue of warrants added another means of participating in the situation. The recent issue of 5,250,000 shares by Bell tripled the amount of stock available. The total amount in the hands of the public, currently, excluding the outstanding warrants, is 7,897,056 shares for an approximate value of $200 million.

Conclusion

We conclude that Northern Electric, because of its aggressive management and its solid base in a highly sophisticated technological field in terms of its research and development efforts, its products and its association with Bell Canada, is expanding rapidly outside its base in Canada and will show impressive sales and profit growth to the end of the 1970's. The stock price, currently, is low relative to the size and stature of the Company and relative to its potential. We recommend the stock.

Toronto, Ontario
December 8, 1975

John L. Drolet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